NUTRITIONAL INTERVENTIONS FOR REDUCING THE NEGATIVE SIDE EFFECTS OF CHEMOTHERAPY[1]

Bill Misner, Ph.D. [2]

Cancer patients typically experience *break-through nausea*, *neutropenia*, and *anemia* from the pharmacology imposed by chemotherapy. This natural nutrition is a proposed remedial menu that reduces negative chemo side effects but does not interfere with chemotherapy's anti-cancer activity. By replacing several depleted substances required for healthy cellular function a few of the negative side effects are resolved. The purpose of this paper is to acquaint the chemotherapy patient with each intervention that reduces some (not all) symptoms during intravenous chemotherapy. Decreasing negative side effects, improving nutrition, in order to reduce deficit red and white blood cell values means results hoped for are highly individual.

NAUSEA

Nausea inhibits healthy nutrient replacement. When nausea prolongs nutrient deficits, white and red blood cell counts will be increasingly depressed resulting in weight loss, depressed red and white cell production, and malaise. Doctors prescribe drugs (antiemetics) to control the expected nausea and vomiting. Regulation of natural whole foods and/or concentrated food or herbal supplements may reduce the onset of nausea by 3 interventions:

1. DO'S ➔ HELPFUL NAUSEA-REDUCING INTERVENTIONS
2. DO NOT'S ➔ AVOID NAUSEA-INDUCING FOODS
3. HOW TO EAT ➔ TECHNIQUES MAKE MEALS EFFECTIVE

[1] This article was originally written in 2002 for the Cancer Cure Foundation, an Alternative Therapy treatment website. The Cancer Cure Foundation is non-profit organization providing information on alternative/integrative therapies, including referrals, since 1976.

[2] Bill Misner Ph.D. is the director of Research & Product Development for E-CAPS INC., a manufacturer of micro- and macro- nutrients specifically formulated for endurance athletes. He is the author of " *NUTRITION FOR ENDURANCE: FINDING ANOTHER GEAR* " Dolezal & Associates Publishing, Livermore California, 1998. Misner is also peer-reviewed and published in the *Townsend Letter for Doctors & Patients*, *Clinical Practice of Alternative Medicine*, and the *International Journal of Clinical Pharmacology Research.* Misner has contributed sportscience articles to magazines: *VOGUE, HEART & SOUL, RUNNERS WORLD, MOUNTAIN BIKE ACTION, & MUSCLE MEDIA*. However, his most significant credential is his wife, Celia, a breast cancer survivor, who during remarkable treatment from the Rockwood Clinic, Spokane, Washington, defined the model subject “Heroine” providing inspiration that requires that this information be shared with others on a similar pathway. Mrs. Misner practiced taking this protocol resulting significant modification of the side effects from chemotherapy and radiation treatment.

DO'S ➔ HELPFUL NAUSEA-REDUCING INTERVENTIONS

RANKED MOST EFFECTIVE TO LESS EFFECTIVE

- Eat foods with minimal odor (Food Scents increase nausea)
- Eat dry cereal, toast, or crackers in the AM (low blood sugar in AM triggers nausea)
- Snack before bedtime, or in the middle of the night (avoid an empty stomach)
- Hydrate frequently in small doses (sipping); Hydration reduces nausea, dehydration increases nausea, force sip clear liquids, tea and ginger ale decrease nausea, and flat soda pop.
- Eat a high protein diet. Try things like shrimp, eggs, tuna, milk, or peanut butter.
- If high protein doesn't work, try a high carbohydrate diet like pasta, rice, potatoes, bananas, toast, and dry cereal.
- Fruits & Vegetables: carrots, jello-peaches, cherries, and apricots
- Find foods well-tolerated
- Add a new food per day for variety
- Get plenty of rest
- Nausea reduced by cold washcloth over eyes
- Dill Pickle alters the metallic taste from chemotherapy drugs
- Anti-nausea Food List: Yogurt, Sherbet, Pretzels (low fat or no-fat preferred), Angel food cake, Skinned chicken (baked or broiled, not fried), Ice chips, Oatmeal, peppermint tea, raspberry-leaf tea, and peppermint-flavored candy.
- "SEABANDS" wrist wrap acupressure points reduces motion sickness (acupressure points on the wrist counteract nausea)
- Anti-nausea Vitamin B-6 (take 20-50mg per day)
- Anti-nausea Herb Ginger Root or Ginger Capsules[3]

DO NOT'S ➔ AVOID NAUSEA-INDUCING FOODS

- AVOID high fat, greasy or fried foods
- AVOID sweets, such as candy, cookies or cake
- AVOID spicy or hot foods
- AVOID foods with strong odors
- AVOID Iron supplements (unless Physician has prescribed)
- AVOID NSAIDs, unless prescribed and/or enteric coated
- AVOID coffee or acidic drinks
- AVOID icy or highly carbonated drinks, or very hot drinks

HOW TO EAT ➔ TECHNIQUES T0 MAKE MEALS EFFECTIVE

- Eat small amounts often and slowly.

[3] GINGER CONTRAINDICATIONS: Ginger is to be used only after consultation with a physician. Side Effects: Heartburn. Drug Interactions: European researchers concluded that ginger might enhance absorption of sulphaguanidine. Excessive consumption of ginger may interfere with cardiac, antidiabetic, or anticoagulant therapy. Patients with gallstones should not take ginger except on the advice of their physician.

- Drink fewer liquids with meals than between meals. Drinking liquids with solid foods can cause a full, bloated feeling.
- Drink or sip liquids throughout the day, *except at mealtimes* for adequate hydration. Dehydration induces nausea, however overhydration also produces nausea. Using a straw may help balance fluid volume intake.
- Eat foods heated to room temperature or cooler; hot foods increase nausea.
- Don't force food when nauseated as this may associate a dislike for mealtimes and specific foods
- Avoid constipation, if bowels "back-up", nausea will worsen.
- Nausea reduction is the goal. Once nausea is controlled by a balanced nutrient intake, this dietary intervention may be further modified to improve Neutropenia (low white blood cell count).

NEUTROPENIA DIET IMPROVES IMMUNE SYSTEM RESPONSE

Neutrophils are an important defense against infection, especially bacterial infection. Treatment and disease progression may compromise neutrophil counts. When neutrophil counts fall below 1000 (1.0 x 109/L), patients are in jeopardy of infections from bacteria found in everyday food. It is important to consume only a low bacteria diet until the immune system returns to normal. Foods must be prepared in such a way to avoid risk of infection from food-born bacteria. If neutrophil count drops near or below 1000, patients should consume a neutropenic diet[4].

How do patients reduce exposure to bacteria on or in food?
The answer is:

1. KEEP FOOD CLEAN BACTERIA-FREE
2. NEUTROPENIC DIET PROTOCOL

KEEP FOOD BACTERIA-FREE

- Check expiration dates on all products before you buy them. Be sure nothing you buy is past its expiration date.
- Wash with soap/citrus cleanser and hot water before and after touching food: counter tops, cutting boards (wash them in a dishwasher if you have one) all cooking utensils, all silverware, and all pots and pans.
- Person preparing food should wash hands frequently with warm soapy water and dry with paper towels. This is especially important after touching raw meat, chicken, eggs, and fish.
- Wash dishes in hot soapy water or in dishwasher.
- Air-dry dishes--DO NOT use cloth towel.
- Keep perishable food very hot or very cold. DO NOT leave perishable items at room temperature for more than 10 to 15 minutes. All perishable foods should be cooked thoroughly. Yes, that means no rare meat.
- Thaw frozen foods in the refrigerator overnight or quickly in the microwave. DO NOT thaw food on the counter.

[4] Patients or their family are encouraged to regularly communicate with their Oncologists or Hematologists.

- Refrigerate leftovers promptly in airtight containers. Use leftovers only if they have been stored properly and have been around for no more than 24 hours.

NEUTROPENIC DIET PROTOCOL

- Give immune system a boost by including live active cultured yogurt containing lactobacillus bulgaricus & strepococcus thermophilus[5].
- Garlic is an appetite stimulating vegetable with anti-cancer properties.
- Zinc stimulates immune-enhancing role in white & red blood cell production. Foods high in zinc are oysters, pot roast, dark meat turkey, pumpkin & squash seeds, a multi-vitamin containing zinc, and shitake mushrooms.
- Fruits and vegetables are immune-boosting foods. They may not increase white cell count, but will make the white cells stronger. The best produce choices are the deep colored (green/orange) spinach, carrots, melon, and oranges.
- Fish Oil is an immune-enhancing agent.
- The neutropenic diet recommends well-cooked foods to eliminate potential disease-causing microorganisms[6].
- Fresh Produce - Always wash fresh or frozen fruits and vegetables thoroughly under running water, microwave or steam until well done, cool cover in the refrigerator, or use in a blended milk shake. Some fresh produce even has better availability of nutrients and phytochemicals with cooking although other nutrients are also decreased with cooking. However, remember that this diet is only for short-term use and do not worry too much about the lost nutrients.
- Use vacuum-packed (pasteurized) tofu to minimize bacterial counts. Change the storage water daily. *Never* buy tofu from open bins or barrels during this time of being immune-suppressed.
- Do not use wheat germ, wheat bran, or flaxseeds stored in open bins.
- Specific Foods Recommended[7] are pasteurized yogurt, peeled thick-skinned, unblemished fresh fruit (banana, citrus, melon - be sure to wash the outside peels prior to cutting through the fruit with knife), peeled apples, cooked dried fruit, processed fruit juices, pasteurized milk, or soy milk.
- Specific Foods to Avoid[8] are fresh-squeezed fruit juice, unpasteurized fruit juice, too many fat, notably polyunsaturated vegetables oils, which adversely affect immune system.
- Blender, blender cover, cutting board and utensils must be kept clean by washing them all in the dishwasher. If you need to wash these items by hand, use warm soapy water, rinse well, and then wash again with a solution of 1-Tablespoon bleach in 4 cups of warm water. Let the solution stay on for at least 2 minutes and then rinse clean with hot clean water.
- Most important: Thoroughly wash hands with soap and water before handling the foods or preparing a blended food shake[9].

---

[5] The author recommends taking iFlora a commercial probiotic with 16 strains probiotics “Good” bacteria at 15 billion count per capsule. Competing Interests Disclosure: The author is affiliated with a company that markets this product, though he receives no direct compensation related to iFlora sales.

[6] Oncology Nutrition Patient Education Materials by Walker and Masino, published by The American Dietetic Association, 1998.

[7] Recommended by The Oncology Nutrition Patient Education Materials
http://www.bccancer.bc.ca/NR/exeres/AC4EA55E-621A-4236-9C64-0EC624F5ABEB.htm

[8] Recommended by The Oncology Nutrition Patient Education Materials
http://www.bccancer.bc.ca/NR/exeres/AC4EA55E-621A-4236-9C64-0EC624F5ABEB.htm

SPECIFIC DIETARY APPLICATIONS	
PERMITTED	NOT PERMITTED
Distilled water, boiled well water, bottled spring water, tap water	Raw, unpasturized milk, eggnog or milk shakes made with raw eggs, fresh apple cider
Shellfish well cooked, home prepared meat, and fish salads, pre-packaged sandwich meats	Raw or rare meat, fish, eggs, poultry commercially prepared meat and fish salads, sushi, and sandwich meats from the deli
Pasteurized or Lactaid milk or yogurt, Pre-packaged ice cream or frozen yogurt, pre-packaged hard cheeses: cheddar, Colby, Monterey jack, Swiss, mozzarella pre-packaged soft cheeses: cottage cheese, cream cheese, ricotta	Soft serve ice cream or frozen yogurt hand-packed ice cream or frozen yogurt, feta, brie, camembert, blue, gorganzola, and quesco fresco cheeses any imported cheeses, and any cheese sliced at a deli
Breads, cereals, rice, potatoes, pasta, all pre-packaged or homemade breads, muffins, cakes, rolls, donuts, cookies and crackers all boxed hot or cold cereals, except those with dried fruit or nuts, cooked potatoes, rice, noodles	Bakery breads, muffins, cakes, donuts, cream, or custard filled cakes, commercially prepared potato, or macaroni salad, popcorn (due to dental problems)
All well washed and thoroughly cooked vegetables, all cooked or canned fruits, raw, thick-skinned, well-washed fruits (unbruised): oranges, grapefruits, melons, bananas, tangerines	Raw vegetables and salads, uncooked thin skinned fruits: apple, peaches, grapes, plums, nectarines, kiwi, strawberries, dried fruits
Processed peanut butter, packaged roasted nuts, cooked nuts (in cookies, cakes, etc)	Raw nuts, uncooked nuts, unprocessed nuts
All cooked fresh or canned spices (add at least 5 min. prior to end of cooking) ketchup, mustard, mayonnaise, served in separate containers with clean utensils, sugar, jelly, honey served from clean containers with clean utensils	Uncooked spices, raw honey, anything from a family container that isn't freshly washed
Thoroughly cooked frozen dinners, thoroughly cooked frozen pizza, canned entrees, do not eat at restaurants for at least two months or use take out deli food even if it's behind the counter, avoid all salad bars for at least one year, avoid all self-serve buffets for at least one year.	Poorly cooked frozen dinners, thoroughly cooked frozen pizza, canned eating at restaurants or eating take-out deli food, avoid salad bars and self-serve buffets

[9] Diana Dyer, MS, RD CNSD, resource @: http://www.cancerrd.com/FAQs/FAQ1.htm

DANA-FARBER FOODS RESTRICTED ON A NEUTROPENIC DIET[10]

1. Raw nuts, vegetables, and salads, apples, peaches, grapes, plums, nectarines, kiwi, strawberries, and other uncooked thin-skinned fruits
2. Self-serve buffets, salad bars, and deli foods
3. Cheeses such as feta, Brie, Camembert, blue, etc.
4. Raw or rare meats, fish, and poultry
5. Commercially prepared potato or macaroni salad
6. Raw, un-pasteurized milk and eggnog or milk shakes made with raw eggs
7. Bakery breads, muffins, cake donuts, and cream or custard filled cakes
8. People preparing food must wash their hands frequently in warm soapy water, especially if handling raw meat, chicken, eggs, and fish.
9. Counter tops, cutting boards, and cooking utensils should also be washed with hot soapy water after they have come in contact with food.

IMPORTANT ADDITIONAL SUGGESTIONS

1. BODYWEIGHT EVALUATION

It is very important to maintain your weight during cancer treatments. If you have a scale weigh yourself weekly. If you notice a loss of five pounds or greater, contact your doctor. You may not wish to eat large amounts of food, so you are advised to maximize the calories you do eat.

1. EAT SMALL, FREQUENT MEALS OR SNACKS

Add margarine, butter, gravy, cheese, and non-fat milk powder to appropriate items. (If you're having dry mouth as a result of treatment you'll really appreciate these suggestions.)
Consume nutritional supplements like ice cream frappes made with enriched milk. To make enriched milk mix 1 quart of milk with 1 cup of dry milk powder. Stir well and keep refrigerated. This increases the protein, calorie and vitamin content of the milk.
Drink Instant breakfast, Ensure, Sustacal, or other commercially prepared supplements.
Some people may have trouble digesting milk products. Watch for symptoms of bloating, gas, cramps, or diarrhea after consuming milk products. You may want to switch to Lactaid Milk, or chew lactaid tablets when eating dairy products. Discuss this with your dietitian, nurse, or doctor.

- IMPORTANT REMINDER: Check with your doctor after blood work is done, to determine when the low bacteria neutropenic-diet may be liberalized. Talk with the doctor or oncology nurse to keep your information up to the minute according to your blood counts.

[10] Dana-Farber Cancer Institute Dietitians (cited 2-13-2002)
http://www.dana-farber.org/pat/support/nutrition/

DIETARY INTERVENTIONS FOR ANEMIA

COMMON CAUSES

The most common cause is iron-deficiency anemia in red blood cells, which are smaller than usual and pale in color due to improper amounts of hemoglobin (the molecule in red blood cells that binds to oxygen and carries it in the blood). This lack of iron for the production of hemoglobin may be due to one or more of the following:

1. Loss of iron from the body due to blood loss
2. Poor absorption of iron from one's diet
3. A deficiency of vitamin B-12
4. A deficiency of folic acid
5. An imbalance between the ratio of B-12 & Folate
6. Lack of dietary iron
7. Radiotherapy or Chemotherapy
8. Anti-cancer drugs
9. Certain types of viral infections
10. Genetic predisposition
11. A side effect from malaria
12. AIDS

SYMPTOMS OF ANEMIA

(Note: There may be no symptoms if anemia is mild.)

1. Tiredness and weakness
2. Lethargy
3. Dizziness, shortness of breath, and palpitations (rapid heart rate)
4. Headaches
5. Pale complexion
6. Brittle nails (due to lack of iron)
7. Irritability
8. Sore tongue
9. Unusual food cravings (called pica)
10. Decreased appetite
11. Headache - frontal
12. Blue tinge to sclerae (whites of eyes)

ANEMIA'S MECHANISMS

Red blood cells that carry iron-rich hemoglobin live only 120 days or four months. Unless there is a continual supply of iron, vitamin B12, vitamin C and folacin from either food or supplements, anemia will result in poorly formed red blood cells that are ineffective carriers of oxygen. Iron deficiency anemia is the most common form of anemia. Approximately 20% of women, 50% of pregnant women, and 3% of men are iron deficient. Iron is an essential component of hemoglobin, the oxygen carrying pigment in

the blood. Iron is normally obtained through the food in the diet and by the recycling of iron from old red blood cells.

The causes of iron deficiency are too little iron in the diet, poor absorption of iron by the body, and loss of blood (including heavy menstrual bleeding). It may also be related to lead poisoning or chemotherapy. Anemia develops slowly after the normal stores of iron have been depleted in the body and in the bone marrow. Women, in general, have smaller stores of iron than men and have increased loss through menstruation, placing them at higher risk for anemia than men.

In men and postmenopausal women, anemia is usually due to gastrointestinal blood loss associated with ulcers, the use of aspirin or nonsteroidal anti-inflammatory medications (NSAIDS), or colon cancer. High-risk groups include: women of child-bearing age who have blood loss through menstruation; pregnant or lactating women who have an increased requirement for iron; infants, children, and adolescents in rapid growth phases; and people with a poor dietary intake of iron through a diet of little or no meat or eggs for several years.

Risk factors related to blood loss are peptic ulcer disease, long term aspirin use, colon cancer, or cancer-related chemotherapy treatment. Dietary sources of iron are red meat, liver, and egg yolks. Flour, bread, and some cereals are fortified with iron. If the diet is deficient in iron, iron should be taken orally monitored by a physician.

DIETARY INTERVENTIONS RESOLVE ANEMIA

Non-heme iron (ferric) is highly variable in its availability for absorption.
Foods high in non-heme iron are grains, vegetables, fruits, eggs and some iron supplements. Absorption of non-heme iron increases in the stomach's acidic environment and the presence of vitamin C in foods. Also, the presence of red meat may increase absorption of non-heme iron four times. However, oxalates and phytates found in dark green leafy vegetables and whole cereal grains decrease the absorption of iron because they bind with iron in the gastrointestinal tract.

Heme iron (ferrous), found in red muscle meats of animals, is far more effectively absorbed. The absorption of heme iron is influenced by other foods in the diet such as foods containing vitamin C and an acid environment like the stomach. The Recommended Dietary Allowance (RDA) for iron is 10 milligrams for adult males and postmenopausal females. Males (ages 11 to 18) need 12 milligrams of iron per day. Females (ages 11 to 50 years) need 15 milligrams.

The best food source of iron is liver and red meats. These foods contain heme iron, which is better absorbed than non-heme iron. Non-heme iron can be found in dark green, leafy vegetables (spinach, chard and kale) and whole cereal grains (bran and whole wheat bread). Include dark green, leafy vegetables and whole cereal grains in your daily diet. Oxalates and phytates found in dark green leafy vegetables and whole cereal grains decrease the absorption of iron because they bind with iron in the gastrointestinal tract.

The anemic person should consume iron-fortified cereals to supplement iron in the diet. Menstruating women should have an annual blood workup from their physician. Anemia may develop on a meat-free diet or iron reserves may be low.

DIETARY SUPPLEMENTS[11]

The author recommends 15 supplements that boost the immune system response:

1. Probiotics ("Good" gut bacteria) - 15 Billion Count/day
2. Coenzyme Q10 - 100-150 mg daily
3. Garlic capsules - 2 capsules 3 x daily
4. Kelp - 100-225 micrograms/day
5. Vitamin B6 - 50 mg 1-3 daily
6. Vitamin B12 - 200-1,000 mcg
7. Folic Acid - 800 mcg
8. Vitamin B Complex - 50-100 mg/day
9. Proteolytic enzymes - Bromelain & Papain 20-25 mg/day
10. Selenium - 200 mcg daily
11. Vitamin A - 15,000 IU daily or Beta Carotene - 25,000 IU daily
12. Vitamin C plus Bioflavonoids – 1000-3000 mg/day or bowel tolerance level
13. Vitamin E - 400 IU daily
14. Copper - 2 mg daily
15. Zinc Chelate 30-50 mg daily (Do not take zinc in amounts over 50 mg daily unless exercise activity exceeds 2 hours per day; the upper recommended level is 100 mg for exercising subjects as 1 mg copper for each 15 mg zinc.)

If these building blocks supplemented with balanced healthy nutrition fail to raise blood values into normal reference ranges, the patient and physician should consider 2 prescription medications, Procrit or Neupogen.

PROCRIT INFORMATION[12] (Epoetin Alfa)

Erythropoietin is a naturally occurring hormone that stimulates the production of red blood cells (RBCs). In the absence of erythropoietin, few RBCs are formed by the bone marrow. In normal adults, approximately 90% of human erythropoietin is produced in the kidney[13] [14]. The level of tissue oxygenation normally regulates endogenous production of erythropoietin. A reduction in the delivery of oxygen to the kidney may occur when the hematocrit (Hct) is low, or as a result of changes in hemoglobin (Hb)-oxygen dissociation. Hypoxia and anemia generally increase the production of erythropoietin, which in turn stimulates erythropoiesis. Erythropoietin increases RBC production by stimulating the division and differentiation of committed erythroid progenitors in the bone marrow. [7] An important effect of erythropoietin is to stimulate the production of proerythroblasts from hematopoietic stem cells in the bone marrow. In addition, once the proerythroblasts are formed, erythropoietin causes these cells to pass through the

[11] As with any supplement, always confer with your physician or nutritionist as to the appropriate level or selection prior to use.
[12] **Procrit @: http://www.procrit.com/**
[13] Guyton AC, Hall JE. Textbook of medical physiology. 9th ed. Philadelphia, PA: W. B. Saunders;1996.
[14] Guyton AC, Hall JE. Human physiology and mechanisms of disease. 6th ed. Philadelphia, PA: W. B. Saunders;1997.

different erythroblastic stages more rapidly; further accelerating the production of new RBCs. Overall, the regulation of erythropoiesis resembles a complete feedback loop.

Erythropoietin, released primarily by the kidney in response to hypoxia, sends a highly specific signal prompting committed erythroid progenitor cells in the bone marrow to produce reticulocytes, which in turn mature into RBCs in the circulation. As a result, the oxygen-carrying capacity increases, the stimulus of hypoxia is alleviated, and the endogenous erythropoietin response is decreased. This feedback loop provides for the normal regulation of erythropoietin.

The first evidence of a response to the weekly administration of PROCRIT is an increase in the reticulocyte count within 20-30 days, followed by gradual increase in the red cell count, hemoglobin, and hematocrit. Because of the length of time required for erythropoiesis -- several days for erythroid progenitors to mature and be released into the circulation -- a clinically significant increase in hematocrit is usually not observed in less than 2 weeks and may require up to 6 weeks in some patients. Once the hematocrit reaches the suggested target range (30-36%), that level can be sustained by PROCRIT therapy in the absence of iron deficiency and concurrent illnesses.

NEUPOGEN[15]

NEUPOGEN is a growth factor that primarily stimulates neutrophils. *NEUPOGEN* is indicated to decrease the incidence of infection, as manifested by febrile neutropenia, in patients with nonmyeloid malignancies receiving myelosuppressive anti-cancer drugs associated with a significant incidence of severe neutropenia with fever. A complete blood count (CBC) and platelet count should be obtained prior to chemotherapy, and twice per week during *NEUPOGEN* therapy to avoid leukocytosis and to monitor the neutrophil count.

In phase 3 clinical studies, *NEUPOGEN* therapy was discontinued when the neutrophil count [ANC] was > 10,000/mm3 after the expected chemotherapy-induced nadir. NEUPOGEN therapy was adjusted to maintain the median ANC between 1500 and 10,000/mm3. Overall, the response to *NEUPOGEN* is observed in 1 to 2 weeks. *NEUPOGEN* therapy daily subcutaneous injections commence 2-4 days post chemotherapy and continue for 7-10 consecutive days. *NEUPOGEN* is contraindicated in patients with known hypersensitivity to E. coli-derived proteins, Filgrastim, or any component of the product. Drugs, which may potentiate the release of neutrophils, such as lithium, should be used with caution. In all phase 2 and 3 trials, medullary bone pain, reported in 24% of patients, was the only consistently observed adverse reaction attributed to

***NEUPOGEN* therapy.**

This bone pain was generally reported to be of mild-to-moderate severity, and could be controlled in most patients with non-narcotic analgesics; infrequently, bone pain was severe enough to require narcotic analgesics. Bone pain was reported more frequently in patients treated with higher doses (20 to 100 mcg/kg/day) administered IV, and less

[15] Neupogen [Filgrastim] Pharmacology Information Available from URL: http://www.neupogen.com/patients/patientpi.html

frequently in patients treated with lower SC doses of *NEUPOGEN* (3 to 10 mcg/kg/day). Shortly after white blood cell counts are compromised, red blood cell counts, hematocrit, hemoglobin, and red blood cell morphology may be depressed lower than normal reference range values. Dietary interventions may be further modified to support rebound red blood cell levels to healthy normal values.

DISCLAIMER: This information is presented for educational purposes only. Please discuss this information with your personal physician or dietitian. If a medical or health concern is present, applications of this information are subject to the approval of your personal physician or licensed health care provider. Altering the intended content or reproduction of this article requires the author's consent. Contact: Bill Misner Ph.D. drbill@omnicast.net @ 1-800-336-1977.