JOURNAL OF NUTRITION FASTING AND HEALTH

Microbial Evaluation of Neutropenic Diet in Bone Marrow Transplant Department in Iran

Mahsa Tousi[1], Abdolreza Norouzy[2*], Mohammad Vaezi[3], Ali Ghasemi[4], Maryam Khosravi[2], Ardeshir Ghavamzadeh[5]

1. Department of Nutrition, School of Medicine, Mashhad University of Medical Sciences, Mashhad, Iran
2. Associate Professor, Department of Nutrition, Faculty of Medicine, Mashhad University of Medical Sciences, Mashhad, Iran
3. Hematology-Oncology and Stem Cell Transplantation Research Center, Shariati Hospital, Tehran University of Medical Sciences, Tehran, Iran
4. Associate professor of pediatric hematology and oncology, faculty of medicine, Mashhad University of Medical Sciences, Mashhad, Iran
5. Hematology-Oncology and Stem Cell Transplantation Research Center, Department of Hematology- and Oncology, Shariati Hospital, Tehran University of Medical Sciences, Tehran, Iran

ARTICLEINFO

Article type:
Original article

Article History:
Received: 06 Jul 2018
Accepted: 16 Aug 2018
Published: 30 Sep 2018

Keywords:
Bacterial contamination
Food-borne
Hematopoietic stem cell transplantation
Neutropenic diet

ABSTRACT

Introduction: The use of a neutropenic diet after hematopoietic stem cell transplantation (HSCT) was instituted more than 30 years ago. This diet was targeted toward preventing from infection with organisms colonizing the gastrointestinal tract and the food-borne pathogens, which are the most important cause of illness and death in developing countries. Regarding this, the present study aimed to evaluate neutropenic diet in patients undergoing bone marrow transplantation in a selected hospital. This study also sought to investigate the role of hospital foods in the transmission of clinically important bacteria to the hospitalized patients.
Methods: This cross-sectional study was conducted on the specimens of the foods served in the Bone Marrow Transplant Department of Shariati Hospital, Tehran, Iran. The samples were evaluated in terms of bacterial contamination using the standard method of American Public Health Association and Food and Drug Administration (FDA).
Results: According to total bacteria and coliform counts, No contamination was detected in any of the tested specimens.
Conclusion: As the findings indicated, the neutropenic diet, was found to be fully in line with the standards of the Ministry of Health and FDA both in terms of guidelines and food analysis.

► *Please cite this paper as*:
Tousi M, Norouzy A, Vaezi M, Ghasemi A, Khosravi M, Ghavamzadeh A. Microbial Evaluation of Neutropenic Diet in Bone Marrow Transplant Department in Iran. J Nutrition Fasting Health. 2017; 6(2): 99-103. DOI: 10.22038/jnfh.2018.33224.1118

Introduction

Hematopoietic stem cell transplantation (HSCT) is a very complex process applied for the treatment of various diseases. Many factors induce changes in the metabolism during HSCT (1). The high dose chemotherapy and total body irradiation therapy that are required before transplantation, as well as the post-transplant complications can cause multiple severe gastrointestinal adverse events. Some of these adverse events include mucositis with painful ulcers, dysgeusia, xerostomia, diminished ingestion, anorexia, nausea, vomiting and diarrhea. These symptoms often lead to poor oral intake requiring interventions to maintain adequate nutrition (2). The nutritional status can be also affected by the duration of the last chemotherapy cycle, infections, and anorexia that is common in cancer patients (3). After chemotherapy, the patients are at a higher risk of infection with bacteria or fungi presenting in foods. This is because the number of the white cells (neutrophils) that fight against food-poisoning bacteria are much lower (neutropenia) the treatment.

Chemotherapy also damages the gut lining, which normally acts as a barrier between bacteria and bloodstream. Patients, specifically those with blood cancer, have a reduced immune

* *Corresponding author:* Abdolreza Norouzy, Nutrition Research Center, School of Medicine, Mashhad University of Medical Sciences, Mashhad, Iran. Tel: +985138002382; Fax: +985138002421; Email: norouzya@mums.ac.ir

response and are at a greater risk of infection. Therefore, they require a neutropenic diet until the recovery of their immune system (4). The neutropenic diet reduces the introduction of food with high levels of bacteria into the body (5, 6), This kind of diet is also called sterile diet, low microbial diet, and low bacterial diet.

The variations of the neutropenic diet include an exclusive sterile diet (e.g., all foods that have been made sterile by canning, baking, autoclaving, and irradiation), low bacterial diet (only well-cooked foods), and modified house diet (i.e., a regular diet omitting fresh fruits and vegetables) (7-10). therefore, most of the oncology centers apply preventive measures to minimize exposure to infectious agents (11).

Despite the necessity of monitoring the neutropenic diet in patients undergoing bone marrow transplantation, limited studies have been performed in Iran to investigate this issue (12). With this background in mind, the present study was conducted to evaluate the neutropenic diet of patients undergoing bone marrow transplantation and investigate the bacterial contamination of hospital food following HSCT.

Material and methods

Microbiological and nutritional quality analyses were performed for the regular and neutropenic diets offered to patients undergoing bone marrow transplantation that were admitted to Shariati hospital, Tehran, Iran. Considering the similarity of food in the whole hospital and its different sections, to ensure the sterility of food used for the patients subjected to bone marrow transplantation, the food samples were collected in sterilized containers and analyzed in ViroMed laboratory in Tehran, Iran, from January to September 2017.

A total of 12 food samples were obtained from the kitchen (sending to the bone marrow transplantation section) of Shariati Hospital on different days.

The food samples included cooked rice, soup (3 turns), rice and chicken (Iranian traditional name: Reshte Polo) (2 turns), veal, cotyledon, and potato (Iranian traditional name: Qeime), rice with green beans and veal (Iranian traditional name: Lobia Polo), rice and vegetables (Iranian traditional name: Sabzi Polo), as well as meat and chicken (2 turns). Sample derivative in each sampling series was taken from the main dish before its consumption by the patients. The food samples were kept in a cool container in accordance with standard conditions and transported to the food lab in the shortest time interval.

Before performing the necessary tests, the samples were mixed and homogenized, and then subjected to the corresponding tests. In order to study the microbial quality of the foods, they were investigated in terms of total counting of bacteria, coliforms, *Staphylococcus aureus*, yeasts, molds, *Bacillus cereus*, *Salmonella* species, and *Escherichia Coli* using the standard method of the American Public Health Association (APHA) (13). In addition, neutropenic diet was studied in these patients based on the available guidelines (8, 14-16).

Results

The pathogens examined in this study were subjected to total bacterial count (Table 1). The results were indicative of a complete compliance of neutropenic diet with the FDA standards without any discrepancies. Table 1 presents the information regarding the counting of the microbial properties of the examined foods. Furthermore, the examination and monitoring of the compliance of the food served in the transplant department under investigation with the neutropenic diet criteria in terms of the intake of fresh fruits, fresh vegetables, raw or undercooked meats and fish, and soft cheese made from unpasteurized milk revealed that the regimen was fully consistent with the given criteria (Table 2) (17).

Table1. Results of the bacterial counts of hospital food samples the standards of the Ministry of Health and Food and Drug Administration

Cooked Rice				
Row	Feature / Test Description	Test result	Unit	Normal range
1	Total bacterial count	5 * 10^2	CFU/g	Maximum 100,000
2	Coliform	Less than 10	CFU/g	Maximum 100
3	*Staphylococcus aureus*	Negative	CFU/g	Negative
4	Molds	10	CFU/g	Maximum 100
5	*Bacillus cereus*	Less than 10	CFU/g	Less than 10
6	*Escherichia Coli*	Negative	CFU/g	Negative

Soup, Qeime, and meat				
Row	Feature / Test Description	Test result	Unit	Normal range
1	Total bacterial count	Less than 10	CFU/g	Maximum 100,000
2	Coliform	Less than 10	CFU/g	Maximum 100
3	*Staphylococcus aureus*	Negative	CFU/g	Negative
4	Molds	Less than 10	CFU/g	Maximum 100
5	*Salmonella species*	Negative	CFU/25g	Negative
6	*Escherichia Coli*	Negative	CFU/g	Negative

Reshte Polo and Sabzi Polo				
Row	Feature / Test Description	Test result	Unit	Normal range
1	Total bacterial count	Less than 10	CFU/g	Maximum 100,000
2	Coliform	Less than 10	CFU/g	Maximum 100
3	*Staphylococcus aureus*	Negative	CFU/g	Negative
4	Molds	Less than 10	CFU/g	Maximum 100
5	*Bacillus cereus*	Less than 10	CFU/g	Less than 10
6	*Salmonella species*	Negative	CFU/25g	Negative
7	*Escherichia Coli*	Negative	CFU/g	Negative

chicken				
Row	Feature / Test Description	Test result	Unit	Normal range
1	Total bacterial count	100	CFU/g	Maximum 100,000
2	Coliform	Less than 10	CFU/g	Maximum 100
3	*Staphylococcus aureus*	Negative	CFU/g	Negative
4	Molds	Less than 10	CFU/g	Maximum 100
5	*Salmonella species*	Negative	CFU/ 25g	Negative
6	*Escherichia Coli*	Negative	CFU/g	Negative

Lobia Polo				
Row	Feature / Test Description	Test result	Unit	Normal range
1	Total bacterial count	100	CFU/g	Maximum 100,000
2	Coliform	Less than 10	CFU/g	Maximum 100
3	*Staphylococcus aureus*	Negative	CFU/g	Negative
4	Molds	Less than 10	CFU/g	Maximum 100
5	*Bacillus cereus*	Less than 10	CFU/g	Less than 10
6	*Salmonella species*	Negative	CFU/25g	Negative
7	*Escherichia Coli*	Negative	CFU/g	Negative

Table 2. Food safety advice during neutropenia

Foods to Avoid	Foods That Can Be Eaten
• Raw and undercooked meats, tofu, eggs, and egg substitutes • Unpasteurized dairy products and juices • Soft cheeses and those with molds, chili peppers, or uncooked vegetables • Raw vegetable sprouts • Raw or non-heat-treated honey • Well water (unless tested daily) • Unroasted nuts or roasted nuts in the shell • Raw grain products • Raw egg-containing foods (e.g.,cookie dough) • Eating at delicatessens	• Hard or processed cheeses and soft cheeses from pasteurized milk • Fully cooked smoked fish or seafood • Hot dogs reheated untile steaming hot • Grilled sandwiches with steaming hot meat or poultry • Fully cooked fish • Fully cooked eggs • Fruits and vegetables that are washed thoroughly (even those with skin that will be peeled or those items claimed to be prewashed) • Cooked vegetable

Discussion

Today, there are several examples of the problems caused by the supply of contaminated food to vulnerable patients in the hospital. These problems can be caused both directly by the intake of food contaminated with intestinal pathogens or microbial toxins and indirectly by the transfer of pathogens responsible for nosocomial infections into the hospital. Cancer patients on chemotherapy are often instructed to follow a neutropenic diet with the goal of reducing the risks of infection and mortality.

This study evaluated the current practices regarding the use of the neutropenic diet among the inpatients undergoing bone marrow

transplantation. As the findings indicated, in Shariati Hospital, the neutropenic diet in patients with bone marrow transplantation that should receive food with the lowest microbial load was in accordance with the FDA guidelines.

Criteria for dietary restrictions vary between hospitals. In this regard, Smith and Besser investigated 400 members of the Association of Community Cancer Centers and reported that 78% of the responding hospitals restricted the diets of the patients with neutropenia (9). In another study, French et al. (2001) examined 10 bone marrow transplant centers in Canada and northwestern United States and reported that five of the seven responding hospitals used a neutropenic diet [18] Furthermore, in another study, 66% of the responding transplant units enforced some types of modified microbial diet (19).

Despite the limited evidence supporting the merits of the neutropenic diet for immunocompromised patients, the restrictive diet continues to be prescribed in the oncology community. In the present study, the neutropenic diet was fully respected in the patients undergoing bone marrow transplantation. In contrary to our findings, Gholammostafaei et al. (2014) reported the outbreaks of food-borne disease in hospitals and the frequency of *Escherichia coli* in the hospital kitchens of Iran as 8% (20). Nevertheless, there is no published study on the microbiological quality of catered food served in the bone marrow transplantation departments in Iran. Therefore, the results of this study could not be compared with any other data.

Conclusion

Considering the importance of neutropenic diet in patients undergoing bone marrow transplantation, our results revealed that this diet was fully in accordance with the standards of the APHA and FDA in the context under investigation.

Acknowledgments

Hereby, we acknowledge the personnel of Shariati Hospital for their contributions to this study. This research was supported by Hematology-Oncology and Stem Cell Transplantation Research Center of Tehran and Mashhad University of Medical Sciences. We also extend our gratitude to the officials of Mashhad University of Medical Sciences for their kind assistance and financial support.

Conflict of interest

The authors have no conflicts of interest.

Financial declaration

This study was supported by a research grant numbered 950256 obtained from the Mashhad University of Medical Sciences, Mashhad, Iran.

References

1. Thompson JL, Duffy J. Nutrition support challenges in hematopoietic stem cell transplant patients. Nutr Clin Pract. 2008; 23(5):533-46.
2. Rzepecki P, Barzal J, Oborska S. Blood and marrow transplantation and nutritional support. Support Care Cancer. 2010; 18(2):57-65.
3. Horsley P, Bauer J, Gallagher B. Poor nutritional status prior to peripheral blood stem cell transplantation is associated with increased length of hospital stay. Bone Marrow Transplant. 2005; 35(11):1113-6.
4. Dykewicz CA. Summary of the guidelines for preventing opportunistic infections among hematopoietic stem cell transplant recipients. Clin Infect Dis. 2001; 33(2):139-44.
5. Foster M. Reevaluating the neutropenic diet: time to change. Clin J Oncol Nurs. 2014; 18(2):239-41.
6. Jubelirer SJ. The benefit of the neutropenic diet: fact or fiction? Oncologist. 2011; 16(5):704-7.
7. DeMille D, Deming P, Lupinacci P, Jacobs LA. The effect of the neutropenic diet in the outpatient setting: a pilot study. Oncol Nurs Forum. 2006; 33(2):337-43.
8. Moody K, Charlson ME, Finlay J. The neutropenic diet: what's the evidence? J Pediatr Hematol Oncol. 2002; 24(9):717-21.
9. Smith LH, Besser SG. Dietary restrictions for patients with neutropenia: a survey of institutional practices. Oncol Nurs Forum. 2000; 27(3):515-20.
10. Todd J, Schmidt M, Christain J, Williams R. The low-bacteria diet for immunocompromised patients: reasonable prudence or clinical superstition? Cancer Pract. 1999; 7(4):205-7.
11. Sarah Tarr B, Allen DH. Evidence does not support the use of a neutropenic diet. Clin J Oncol Nurs. 2009; 13(6):617.
12. Hadjibabaie M, Iravani M, Taghizadeh M, Ataie-Jafari A, Shamshiri AR, Mousavi SA, et al. Evaluation of nutritional status in patients undergoing hematopoietic SCT. Bone Marrow Transplan. 2008; 42(7):469-73.
13. Vanderzant C, Splittstoesser DF. Compendium of methods for the microbiological examination of foods. APHA. 1995; 579(67):663.

14. Fox N, Freifeld AG. The neutropenic diet reviewed: moving toward a safe food handling approach. Oncology. 2012; 26(6):572-5.
15. Boeckh M. Neutropenic diet–good practice or myth? Biol Blood Marrow Transplant. 2012; 18(9):1318-9.
16. Braun LE, Chen H, Frangoul H. Significant inconsistency among pediatric oncologists in the use of the neutropenic diet. Pediatr Blood Cancer. 2014; 61(10):1806-10.
17. Foster M. Reevaluating the neutropenic diet: time to change. Clin J Oncol Nurs. 2014; 18(2):239-41.
18. French MR, Levy-Milne R, Zibrik D. A survey of the use of low microbial diets in pediatric bone marrow transplant programs. J Am Dietet Assoc. 2001; 101(10):1194-8.
19. Poe SS, Larson E, McGuire D, Krumm S. A national survey of infection prevention practices on bone marrow transplant units. Oncol Nurs Forum. 1994; 21(10):1687-94.
20. Gholammostafaei F, Alebouyeh M, Jabari F, Asadzadehaghdaei H, Zali M, Solaimannejad K. Prevalence of antibiotic resistant bacteria isolated from foodstuff in kitchen of a hospital in Tehran. J Ilam Univ Med Sci. 2014; 22(2):1-9. (Persian)