

Review

The Dietary Adjustment to the Digestive System's Alterations Induced by the Anticancer Therapy

T. Mogoș, Andra Evelin Iacobini

"N. Paulescu" Institute of Diabetes & Metabolic Diseases, Bucharest, Romania

REZUMAT

Ajustările dietetice pentru alterările sistemului digestiv induse de terapia anticanceroasă

Boala canceroasă, cu topografia ei atât de variată, întâmpină serioase probleme de alimentare, mai ales dacă pacientul este supus terapiei oncologice. În articolul de față, în funcție de tipul de localizare (de la cap la pancreas, pe traiectul digestiv), de intervențiile oncologice ce sunt necesare, se prezintă maximum de nutriție ce se poate asigura pacientului pentru ca acesta să poată supraviețui mai mult și în condiții mai bune.

Cuvinte cheie: cancer, nutriție, oncoterapie

ABSTRACT

The cancerous disease, with its various topography, faces serious problems concerning nutrition, mainly in the case of patients undergoing oncologic therapy. In this article, depending on the localisation (from head to pancreas, following the digestive tract), in accordance with the oncologic intervention, there are several nutrition measures that can be applied, in order to offer the patients a longer life expectation and a higher quality of it.

Key words: cancer, nutrition, oncotherapy

The nutrition of patients in which the cancerous disease has already spread does not cure the disease [1]. This statement is radically contrary to multiple theories supported by some followers of these cancer specific diets (ex. the shark cartilage diet, the distilled water and wheat seeds diet, etc.). This situation is also encountered in the neoplasm of the digestive system [1].

Corresponding author: Dr. Tiberius Mogoș, Doctor in Medicine
chief physician in Diabetes, Nutrition and Metabolic Diseases, specialist physician in Internal Medicine,
at "N. Paulescu" Institute of Diabetes & Metabolic Diseases, Bucharest, Romania
e-mail: tibimogos@yahoo.com

The objectives of the cancerous disease's nutrition are represented by the ability to provide the caloric and nutritional requirements which are able to improve the patient's clinical status, to increase the effort capacity, to extend the survival duration and to amplify the capacity to tolerate chemotherapy and radiation therapy [2].

The establishment of anticancer therapy is sometimes accompanied by alterations of the digestive system. Although some of these can also exist in the absence of anticancerous therapy (ex. nausea, vomiting, dysphagia, alterations of taste, anorexia, etc.), its administration can emphasize and diversify these manifestations [3, 4].

The affect of the digestive system in the mentioned conditions has important implications upon the patients' nutritional status, as it limits the ability to provide the required nutritional support, the absorption of nutritional principles and their metabolism [5].

Head and Neck Cancer

The patients with head or neck cancer often present a quite pronounced denutritional status before the outset of anticancer therapy. This matter is due on the one hand to the difficulties of food support created by cancerous disease localized at this level, and on the other side to the fact that a significant percentage of these patients are inveterate alcohol consumers, which creates secondary denutrition [2].

In this case, before the administration of any anticancerous therapies, we must search for different ways to provide a proper nutrition, capable to remove the nutritional deficiency.

The set up of anticancer therapy frequently involves the combination of chemotherapy, radiation therapy and surgical treatment, all considerably capable of altering the possibilities of normal nourishment and the desire of adequate feeding [3].

The radiation therapy leads to the loss of taste sensation and xerostomia. The surgical treatment can lead to total or partial resections of the tongue or mandible, of portions of the hard or soft palate, of some masticatory muscles, etc. These surgical procedures raise difficulties when it comes to mastication and swallowing processes. If there are created conditions favorable to aspiration of alimentary bolus, it is necessary to resort to tube feeding. The risk of aspiration of regurgitated foods makes unsafe the placement of the tube's head in

the inferior esophagus or stomach. This risk can be lowered through the administration of nutritional products in slow rhythm (a few hours) under an infusion pump's control. Much more reliable is the placement of the tube's head in the superior portion of the small intestine (the feeding tube is better tolerated and can be left in this position for a longer period of time, until certain factors impose its temporary removal) [6].

Another aspect of nutritional difficulties in patients with neck cancer is represented by the interference of surgical and radiotherapeutical acts with the placement of a catheter in the neck or subclavian area for nutritional purposes. In such cases, we provide the required nutrition through a peripheral venous catheter or a feeding tube. When there is the possibility of resuming oral alimentation after anticancerous therapy, the process of feeding using the previously mentioned means will be discontinued. The re-feeding is started using products that are as attractive as possible when it comes to taste and looks, rich in calories and nutritional principles. In the case of any important difficulties encountered while mastication, we turn to various liquid nutritional formulas, provided that the patient is able to swallow. When the process of swallowing is altered, these liquid products are inserted through feeding tubes [2].

Esophageal Cancer

The set up of anticancerous therapy in the case of esophageal neoplasms results in multiple consequences concerning the nutrition of these patients [3].

Therefore, the radiation therapy can induce esophagitis (which additionally increases dysphagia), which although most of the times fades away after the interruption of treatment, sometimes can be accompanied by fibrosis with consecutive esophageal stricture.

Chemotherapy can produce nausea, anorexia, dryness in the mouth, pain when swallowing, all elements that limit the oral required dietary intakes and decrease the acceptability of tube feeding [3].

The surgical treatment usually involves total or distal esophagectomy requiring bilateral vagotomy, proximal gastrectomy, and the ascent of the stomach in the thoracic cavity (secondary to the esophageal resection). These alterations induced by surgical manoeuvres can be accompanied by frequent post-operative regurgitations, early satiety, reduction in

stomach emptying rate despite of pyloroplasty, intermittent or continuous diarrhea, mild to moderate degree of steatorrhea. The causes of diarrhea and steatorrhea occurrence are unknown [2].

Taking into account the previously mentioned symptomatology, the treated esophageal cancer's dietotherapy acquires particular features. Even before the onset of anticancerous therapy, the presence of progressive dysphagia, which limits the dietary intake, creates a significant weight loss. When the obstruction is incomplete, we turn to liquid nutritional supplements, rich in calories and nutritional principles. In case of pronounced associated anorexia, we resort to nourishment using feeding tube.

We specify that during chemotherapy and radiation therapy, both oral and tube feeding are inadequate to meet nutritional needs, as the treatment interferes with feeding schedule, nausea, vomiting, etc. Due to these reasons, in order to reach an acceptable nutritional status, we recommend parenteral nutrition [6].

Postoperative nutrition of these patients is rendered through small frequent meals, in order to overcome both early satiety and tendency to regurgitation. The alimentary sources will provide a high concentration of carbohydrates and proteins. If steatorrhea is significant, we reduce the long-chain triglycerides, compensatory administering medium-chain triglycerides (absorbed 4 times easier in comparison with the ones with long-chain) [2].

If the stomach has suffered any surgical procedures, there is no need for a specific antidumping diet, as on one side the gastroduodenal continuity is kept, and, on the other hand, the gastric emptying time slows down (secondary to vagotomy), despite of associated pyloroplasty. Nevertheless, symptoms specific to dumping syndrome can occur if hyper-osmolar liquid nutritional supplements are used in large quantities or if these nutritional preparations are rapidly administrated through feeding tubes. In order to avoid any dumping symptomatology, the hyper-osmolar liquid nutritional supplements should be used gradually, in small quantities, possibly diluted [7].

Gastric Cancer

The gastric neoplasm majorly benefits from surgical treatment. It consists of high subtotal gastrectomy with gastrojejunal anastomosis, or total

gastrectomy with esophagojejunostomy. The total or partial resection of the stomach has negative outcomes over the nutritional status. This fact is due to the reduction or disappearance of gastric reservoir function (therefore the early satiety is favoured), the reduction of digestive function (the food's contact with the acid gastric secretion is reduced or disappears, so malabsorption through the lack of an effective gastric digestion is favoured), the alteration of controlled evacuation of gastric content (risk of late hypoglycemia, dumping syndrome) [3].

The nutritional consequences of gastrectomy depend upon the extent of gastric resection, the individual response and the preventive intervention of dietary approaches [2].

The dumping syndrome (occurring while or immediately after serving a meal, due to abrupt jejunal entrance of the gastric content, which leads to intestinal transudate with consequent reduction of plasmatic volume and irritation of jejunal interoreceptors; these phenomena are more striking after the consumption of hypertonic foods; the patients present with weakness, dizziness, sweat, vasomotor collapse, abdominal pain), can be diminished or prevented through the adjustment of an adequate diet. The alimentary regimen is rich in proteins and fats, but reduced in carbohydrates (they predominantly derive from the ones with slow absorption: cereals and vegetables; the consumption of sugar must be avoided). The carbohydrates' intake is limited to 100 – 200 grams per day. They are evenly distributed to all meals along the day. The fats can reach up to 40 % of caloric intake (thereby the gastric emptying time is slowed down and the caloric support for weight gain is increased). Whereas the anti-dumping diet tends to be rich in long-chain triglycerides, and the patients concomitantly presents with maldigestion and malabsorption, a significant steatorrhea installs. In order to diminish it, long-chain triglycerides are progressively replaced with medium-chain triglycerides (better tolerated; absorbed 4 times more than the ones with long chain). The last can be used while cooking, both in various fillings and nutritious drinks. Proteins represent on an average about 20 % from the caloric intake. They must be used at each meal.

The meals must be reduced in volume, frequent, and with the lowest possible hydric content. We prescribe at least 6 meals, evenly distributed along the day. The food portions are progressively increased, according to the improvement of

individual tolerance [2, 3, 8, 9].

All liquids must be consumed 45 to 60 minutes after the ingestion of solid foods. Each time, we will not use more than 120 milliliters.

The temperature of used products must be moderate (especially cold drinks increase gastric motility and accordingly the gastric emptying rate).

The patients must be encouraged to eat slowly and then to lie down still for 20-30 minutes. Also, they will be provided with a large variety of foods, in order to both satisfy culinary preferences and gain weight [10].

When lactose intolerance occurs, treated milk can be used, a milk in which the lactose has been hydrolysed, yogurt (according to individual

tolerance) or milk used in small and repeated quantities, in which there has been added one teaspoon of calcium carbonate in each 250 milliliters (it reduces intestinal fermentations due to lactose). This way, we pursue to keep the most important source of calcium. If the previous methods prove to be unsatisfactorily, we resort to the daily administration of calcium salts that can provide at least 1 gram of calcium and can be equally distributed to each meal [10].

In **table 1**, we reproduce the alimentary permissions and interdictions in dumping syndrome.

In the course of time, we can explore the progress of nutrition towards one close to the normal (with 3 meals a day; more carbohydrates and the shortening

Table 1. Permitted and prohibited foods in dumping syndrome

Type of food	Quantity	Permitted foods	Prohibited foods
Milk	360 milliliters (at most 120 milliliters per serving)	Whole milk, buttermilk (the tolerance to dairy products must be tested)	All milk based drinks sweetened with sugar; milk if it is not tolerated or recommended by the doctor
Other drinks	Can be consumed according to the instructions mentioned in the text concerning the administration of liquids	Tea, coffee, lemonade (sweetened with sugar substitutes)	Sweetened fruit juices, cocoa, chocolate, alcohol (beer included), carbonated beverages
Soups	A small serving	Cream soups	All other soups, tomato paste
Meat, chicken, fish	500 grams	All, depending upon the patient's tolerance	None of the ones not tolerated by the patient
Cheese	30 – 50 grams	All cheeses	None
Potatoes, bread or substitutes	6 (pieces or slices)	All, except the excluded ones	Sweet pastry products, wafers, muffins, bread in large amounts
Cereals	1 serving	All types	Sweetened cereals, whole grains (if not tolerated by the patient)
Vegetables	2 servings (120 grams per serving)	All, except the forbidden ones	Green vegetables if not tolerated by the patient (maize, Lima beans)
Fruits	200 grams (a citrus fruit or 120 milliliters citric juice included)	Fresh, preserved or cooked fruits (with no added sugar)	Heat treated or preserved with sugar fruits, sweetened fruit juice, fresh intolerated fruits
Butter or fats	150 grams	Butter, sour cream, margarine, oil, fats, mayonnaise	
Desserts	1 serving	Jelly cooked with no sugar added, just with sugar substitutes, sweet cottage cheese with whipped cream, pudding	Cakes, cookies, sorbet, ice-cream, sweet sauces, jelly, candies
Various products	With moderation	Nuts, peanut butter, salt, sugar substitutes	Sugar, jam, marmelade, syrups, treacle, chocolate, popcorn, potato chips, spices, chilli sauce, vinegar, mustard, jello pudding, honey

of time interval between the consumption of solid and liquid foods). If the dietary measures prove to be effete in avoiding the dumping syndrome, or if they do not allow the weight maintenance or growth, then we resort to discontinuous feeding through feeding tubes adapted to a slow feeding system "by drops". In this case, we resort to nutritional supplements specific for this type of feeding. As these products are very slowly introduced, the dumping syndrome does not appear [2, 3, 8].

This type of feeding is also indicated during post-operative chemotherapy, when the installed anorexia makes it very hard to use oral feeding. In patients with anorexia after the interruption of chemotherapy (even if gastric cancer does not represent a problem anymore), it is advisable to continue tube feeding also during night [9].

Regardless of the enteral way of nutrition, the presence of malabsorption requires taking prophylactic and curative measures against vitamin and mineral deficiency. Generally, there is no need to use pharmaceutical drugs highly concentrated in vitamins. It is important to resort to drugs with a complete multivitamin composition. Nevertheless, when steatorrhea is significant, we increase the intake of vitamin D. As a mineral supplement, we resort especially to iron [9].

With regard to dietary therapy in postprandial hypoglycemia (occurring in gastrectomized patients, 2 or 3 hours after meals, because of the rapid progression of foods in the intestine, followed by the rapid increase of blood sugar, the magnified secretion of insulin and subsequent decrease of glycemia below the physiological threshold), it pursues, just like the antidumping one, the slow down of gastric emptying and slow absorbable carbohydrates supply (from cereals, vegetables) in quantities of at the most 200 grams per day. It is recommended the consumption of solid foods as they leave with difficulty the remaining gastric cavity. In the eventuality of using soups, these are consumed in small servings, after solid foods. The soups are cooked by thickening them with mashed vegetables, cheese or pasta, egg flakes. The meals are small and repeated (at least 6 a day). The foods will be properly minced or boiled, as the gastric digestion is significantly diminished. After each meal, the postprandial rest period in lay back position is recommended, in order to slow down the gastro-intestinal transit. No liquids will be used during meal, as they accelerate the gastric emptying [5].

Pancreatic Cancer

The pancreatic cancer is surgically treated. We can practise partial, regional or total pancreatic resection [4, 10].

The partial pancreatectomy is performed at the same time with the removal of the distal region of the stomach, the removal of the duodenum and first few centimeters of jejunum. The ensemble of surgical alterations previously mentioned are performed during the so called pancreaticoduodenectomy. The remaining pancreas is connected by anastomosis with the jejunum or stomach. The nutritional consequences resulted from these surgical procedures are assigned to the malabsorption (occurring preoperative due to malignant obstruction of pancreatic and biliary secretory ducts) and the emerging of diabetes mellitus (at 10 – 20 % of patients). They are mostly expressed through malabsorption of fats (at 27 – 50 % of patients) and hydroelectrolytic losses secondary to osmotic diuresis induced by glycosuria. These biological alterations lead to weight loss in these patients [8].

The total pancreatectomy is performed in order to remove the risk of any malignant degenerations in the remaining pancreas and to avoid the danger of pancreatic fistula occurrence. Nevertheless, this surgical procedure creates severe nutritional imbalances. Even if optimal doses of pancreatic extracts are used, there is a decrease in tissular supplies of fats and proteins. The nutritional imbalance is emphasized in the absence of a proper antidiabetic treatment [9].

Apart from the complete resection of the pancreas, the regional pancreatectomy implies the removal of adjacent tissues (distal stomach, duodenum, spleen, gallbladder, pancreatic segment of portal vein, etc.) and primary lymphatic drainage. Due to secondary anorexia, malabsorption and severe diarrhea, these patients benefit from total parenteral nutrition [1].

From the point of view of the facts previously mentioned, the nutrition of surgical treated pancreatic cancer patients must overcome numerous impediments in order to improve the nutritional status, represented by anorexia, pancreatic insufficiency, diabetes mellitus, gastric and certain intestinal segmental resections, etc. [5].

For these reasons, the servings are small and frequent (at least 6 a day), with an adequate quantity of nutritional principles (carbohydrates are chosen

only among the ones with slow absorption and are given with restrictions; due to biliopancreatic insufficiency, medium-chain triglycerides are preferred, as they absorb 4 times more than long-chain triglycerides) and calories. The patients will consume within the medical permitted limits their favourite foods, as much as pleasantly served.

During each meal, optimal doses of pancreatic

extract are administered [11]. Nevertheless, insulin therapy must be adequate, in order to optimise the usage of carbohydrates (it favours weight gain) and to minimise liquid and electrolyte losses through urine (secondary to increased glycosuria). When nutritional challenges are severe and total parenteral nutrition is still unindicated, intermittent feeding through tube should be used. In this case, we use special nutrition-

Table 2. Nutritional products with protein hydrolysate or aminoacids, minimal residuum and without lactose, used in tube feeding of patients with surgically treated pancreatic cancer (examples)

Name of Product	Criticare HN	Nutrex Aminex	Pepti 2000	Reabilan
Company Name	Mead Johnson	Nutrex	Sherwood Medical	Roussel
Proteins, g (% from total kcal)	36 (14 %)	38.2 (15 %)	40 (16 %)	31.5 (13 %)
Source	casein hydrolysate	crystallized amino acids	lactalbumin hydrolysate	casein peptides, wheat peptides
Fats, g (% from total kcal)	3 (3 %)	2.8 (3 %)	10 (9 %)	38.9 (34 %)
Source	sunflower oil	sunflower oil	medium-chain triglycerides oil 5 (4 %), maize oil 5 (5 %)	medium-chain triglycerides oil 15.5 (12 %), Oenothera biennis oil, soybean oil, lecithin
Carbohydrates, g (% from total kcal)	210 (83 %)	205.7 (82 %)	188.8 (76 %)	131.5 (53 %)
Source	maltodextrins	maltodextrins modified amidon	maltodextrins	maltodextrins tapioca amidon
Volume for 1000 kcal (ml)	946	1000	1000	1000
Minerals				
calcium, mg	500	499.5	625	498.7
phosphorus, mg	500	499.5	625	498.7
magnesium, mg	200	199.8	250	250.7
iron, mcg	9	9	11.3	10
iodine, mg	75	74.9	100	74.7
copper, mg	1	1	1.5	1.6
manganese, mg	2.5	1	2.5	2
zinc, mg	10	10	15	10
chromium, mcg	-	16.6	-	-
selenium, mcg	-	50	-	50.7
molybdenum, mcg	-	50	-	-
sodium, mEq	26	20	29.6	30.4
potassium, mEq	32	20	29.5	31.1
chlorine, mEq	28	23.1	29.9	56.3
mOsm/kg	650	600	490	350
Volume able to provide daily needs of nutritional principles (vitamins included)	1892 ml	2000 ml	1600 ml	2000 ml

Name of Product	Reabilan HN	Travesol STD	Travasorb HN	Vital HN
Company Name	Roussel	Travenol	Travenol	Ross
Proteins, g (% from total kcal)	43.6 (17 %)	30 (12 %)	45 (18 %)	41.7 (17 %)
Source	wheat peptides casein peptides	lactalbumin hydrolysate	lactalbumin hydrolysate	wheat, meat and soy hydrolysate
Fats, g (% from total kcal)	39 (36 %)	13.4 (11 %)	13.4 (11 %)	10.8 (8 %)
Source	medium-chain triglycerides oil Oenothera biennis oil soybean oil lecithin	medium-chain triglycerides oil, 9 (7 %) sunflower oil 4.4 (4 %)	medium-chain triglycerides oil, 9 (7 %) sunflower oil 4.4 (4 %)	sunflower oil 5.9 (5 %) medium-chain triglycerides oil, 4.9 (3 %)
Carbohydrates, g (% from total kcal)	118.6 (47 %)	190 (76 %)	175 (70 %)	188.3 (75 %)
Source	maltodextrins tapioca amidon	oligosaccharides containing only glucose	oligosaccharides containing only glucose	maize amidon hydrolysate, glucose
Volume for 1000 kcal (ml)	750	1000	1000	1000
Minerals				
calcium, mg	338	500	500	667
phosphorus, mg	376	500	500	667
magnesium, mg	248	200	200	267
iron, mg	10	9	9	12
iodine, mcg	76	75	75	100
copper, mg	1	1	1	1.3
manganese, mg	2	1.3	1.3	2.5
zinc, mg	10	7.5	7.5	10
chromium, mcg	62	-	-	-
selenium, mcg	50	-	-	-
molybdenum, mcg	-	-	-	-
sodium, mEq	32.6	40	40	16.7
potassium, mEq	31.9	30	30	29.8
chlorine, mEq	52.8	42.9	39	18.8
mOsm/kg	490	560	560	460
Volume able to provide daily needs of nutritional principles (vitamins included)	2000 ml	2000 ml	2000 ml	1500 ml

Name of Product	Vivonex	Vivonex HN	Vivonex T.E.N.
Company Name	Norwich Eaton	Norwich Eaton	Norwich Eaton
Proteins, g (% from total kcal)	21.8 (9 %)	44.4 (17 %)	38.2 (15 %)
Source	crystallized amino acids	crystallized amino acids	crystallized amino acids (33 %) with ramified chain
Fats, g (% from total kcal)	1.4 (1 %)	0.9 (1 %)	2.8 (2 %)
Source	sunflower oil	sunflower oil	sunflower oil
Carbohydrates, g (% from total kcal)	230.6 (90 %)	210 (82 %)	205.6 (82 %)
Source	oligosaccharides containing only glucose	oligosaccharides containing only glucose	maltodextrins modified amidon
Volume for 1000 kcal (ml)	1000	1000	1000
Minerals			
calcium, mg	550	330	500
phosphorus, mg	550	330	500
magnesium, mg	222.2	133	200
iron, mg	10	6	9
iodine, mcg	83.3	50	75
copper, mg	1.1	0.7	1
manganese, mg	1.6	0.9	0.9

Name of Product	Vivonex	Vivonex HN	Vivonex T.E.N.
.zinc, mg	8.3	5	10
chromium, mcg	27.8	16.7	17
selenium, mcg	83	50	50
molybdenum, mcg	83	50	50
sodium, mEq	20.4	23	20
potassium, mEq	30	30	20
chlorine, mEq	20.4	23.1	25
mOsm/kg	550	810	630
Volume able to provide daily needs of nutritional principles vitamins included)	1800 ml	3000 ml	2000 ml

al supplements, containing protein hydrolysate, oligo-saccharides, medium-chain triglycerides, minerals and vitamins. The components of mentioned products don't require the presence of pancreatic juice for absorption. In order to improve absorption, tube feeding is administered very slowly [10].

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