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## Original

# Nutritional intervention improves the caloric and proteic ingestion of head and neck cancer patients under radiotherapy

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## Abstract

Malnutrition is commonly associated with head and neck cancer, due especially to anorexia, which is aggravated by radiotherapy. The objective of this study was to evaluate modifications to nutritional ingestion following three types of nutritional intervention. Sixty-four male out-patients ( $62.1 \pm 1.5$  years) were divided into three groups: oral group, (n = 32) that received an adapted oral diet; feeding tube group, (n = 16) under home enteral nutrition via a nasoenteral feeding tube (6x/day); and supplement group, (n = 16) with oral diet associated to oral alimentary supplement between meals (3x/day). The groups were homogeneous and counseled to maintain a caloric ingestion of 40 kcal/kg. The diet for the oral group was adapted to the age and to the side effects of radiotherapy. The nutritional state of the three groups was evaluated for the caloric-proteic ingestion, anthropometric indicators (body weight, body mass index, triceps skinfold thickness, midarm muscle area), laboratorial indicators (total proteins, albumin, hematocrit, hemoglobin and total lymphocytes count). The results showed that all of the groups presented an increase in the ingestion of calories and proteins ( $p < 0.001$ ).

**Conclusions:** 1. the nutritional therapy support for patients with head and neck cancer under radiotherapy, whether exclusive oral diet, enteral through a feeding tube, or with alimentary supplement associated to an oral diet achieved a significant increase in the total caloric ingestion. It is recommended that programs be implemented to improve the ingestion of foods among these patients.

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Key words: Nutritional intervention. Head and neck cancer. Radiotherapy. Enteral nutrition.

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## LA INTERVENCIÓN NUTRICIONAL MEJORA LA INGESTIÓN CALÓRICA Y PROTEICA DE LOS PACIENTES CON CÁNCER DE CABEZA Y CUELLO SOMETIDOS A RADIOTERAPIA

### Resumen

La malnutrición se asocia habitualmente con el cáncer de cabeza y cuello, especialmente debida a la anorexia, que se agrava por la radioterapia. El objetivo de este estudio fue evaluar las modificaciones de la ingestión nutricional tras tres tipos de intervención nutricional. Se dividió a 64 pacientes varones ( $62,1 \pm 1,5$  años) en tres grupos: el grupo oral (n = 32), que recibió una dieta oral adaptada; el grupo con sonda de alimentación (n = 16), con nutrición enteral domiciliar a través de una sonda nasointestinal de alimentación (6 veces/día); y el grupo con suplemento (n = 16) con dieta oral asociada a un suplemento alimenticio oral entre las comidas (3 veces/día). Los grupos eran homogéneos y orientados para mantener una ingestión calórica de 40 kcal/kg. La dieta para el grupo oral se adaptó a la edad y los efectos adversos de la radioterapia. Se evaluó el estado nutricional de los tres grupos con respecto a la ingestión calórica-proteica, los indicadores antropométricos (peso corporal, índice de masa corporal, grosor del pliegue cutáneo tricipital, y el área muscular en el brazo medio), los indicadores de laboratorio (proteínas totales, albúmina, hematocrito, hemoglobina y recuento de leucocitos totales). Los resultados mostraron que todos los grupos presentaban un aumento en la ingestión de calorías y proteínas ( $p < 0,001$ ).

**Conclusiones:** 1. El tratamiento nutricional de soporte en pacientes con cáncer de cabeza y cuello sometidos a radioterapia consiguió un aumento significativo en la ingestión calórica total, ya sea mediante alimentación oral exclusiva, mediante sonda de alimentación enteral, o mediante un suplemento alimenticio asociado con la dieta oral. Se recomienda la implantación de programas para mejorar la ingestión de alimentos en estos pacientes.

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Palabras clave: Intervención nutricional. Cáncer de cabeza y cuello. Radioterapia. Nutrición enteral.

## Introduction

Patients with head and neck cancer submitted to radiotherapy can develop radiomucositis, odinophagy, xerostomia and taste dysfunction, these symptoms usually appear after the first week of therapy and reduce the oral ingestion of foods<sup>1, 2, 3, 4, 5, 6, 7</sup>.

Anorexia, or loss of appetite is frequent among these patients<sup>10</sup>, and is also attributed to changes in the function of the hypothalamus, taste dysfunction, food aversion, early satiation and psychological stress arising from the cancer diagnosis<sup>1, 2, 3, 6, 7, 11, 13</sup>.

Patients submitted to radiotherapy, in general tolerate the radiation well, provided that the principles of total treatment dose are respected and it is fractionated. All the tissues can be affected, although to varying degrees. Prior or concomitant surgery and chemotherapy can contribute to an aggravation of the side effects<sup>2, 3, 6, 11, 12, 14, 15, 16, 17</sup>.

Side effects from radiation can augment the nutritional risks in cancer patients<sup>3, 6, 11, 12</sup>, and their severity depends on the treated area, volume, dose and duration of treatment<sup>6, 11</sup>.

Anorexia and malnutrition in cancer necessitates nutritional management that includes a specialized oral diet, oral supplements and even the use of enteral nutritional therapy.

Enteral nutritional therapy can benefit some cancer patients that are undernourished or suffering side effects from the radiotherapy which can impede an appropriate oral ingestion for more than a week<sup>18</sup>. Nevertheless, there is controversy in the literature regarding the precise indication for the type of nutritional therapy<sup>7, 33</sup>.

Nutritional care is currently recommended for patients with cancer of the head and neck, before, during and after antineoplastic treatment<sup>20, 40</sup>.

The objective of this research was to verify the modification of the caloric and protein supply according to the various types of nutritional intervention in patients with head and neck cancer undergoing radiotherapy.

## Patients and methods

The present prospective study comprised 64 patients (mean age = 62 ± 1.5 years) with head and neck cancer that were submitted to exclusive complementary radiotherapy in the postoperative period of surgery and that were attended at the Radiotherapy Clinic of the Department of Nutrition and Dietetics of the Institute of Radiology, Clinicas Hospital, University of São Paulo Medical School, according to the nutritional attendance protocol<sup>14</sup>.

The patients were distributed into three groups:

- oral group: 32 patients fed with oral diet adapted as necessary in terms of fractioning and consistency;
- feeding tube group: 16 patients under home enteral nutritional therapy via nasoenteral feeding tube

**Table I**

*Formulation of the nutritionally complete reconstituted enteral powdered polymeric diet per 100 ml of the product for consumption in the recommended dilutions*

<i>Nutrients</i>	<i>Quantity</i>
Proteins (soya 78.5% and albumin 21.5%)	5.6 g
Lipids (soya extract 51% and coconut fat 37.5%) Corn oil 8.5% and lecithin of soya 3%	5.6 g
Carbohydrates (Malt dextrin 90% and polysaccharides 10.0%)	20.8 g
Linoleic acid (11.5% of total energetic value)	2.0 g
Total energetic value	156.0 kcal

exclusively using a reconstituted powdered enteral diet, the formula of which is given in table I.

- supplement group: 16 patients fed on an oral diet augmented with alimentary supplement using the same reconstituted powdered enteral diet.

The patients were required to prepare their diet at home, in accordance with a printed form providing instructions for diet by feeding tube, elaborated by the Program of Home Nutritional Support (PROSNED).

Exclusion criteria were: life expectancy less than 2 months; previous or current malignant neoplasias of other organs; malabsorption syndrome; hepatic or renal insufficiency; and abandonment of the treatment.

The patients were treated by teletherapy on average for 70 ± 3 days, with a mean total dose of 6000 ± 1414 Gy (5000 to 7000) and a daily dose rate from 180 to 200 Gy.

The patients received explanations about the nutritional service in the initial consultation and signed the term of free and informed consent.

## Nutritional attendance

The specialized ambulatory nutritional attendance began with an evaluation of the medical referral followed by determination of the consultative care required, which was usually tertiary, due to the nutritional risk presented as well as the tumor location, cancer anorexia and side effects from radiotherapy. Measurements and data were collected in the subsequent visits.

All stages of the systematized attendance were registered in the diet-therapy card and annexed to the patients' medical records.

## Evaluation of the Nutritional State

Evaluation of the nutritional state was carried out in the initial and final nutritional consultation and was based on dietary, anthropometric and laboratorial indicators.

Dietary indicators were by estimation of the mean habitual ingestion of calories and total proteins, on the

**Table II**  
Modification to the caloric and proteic ingestion in the three nutritional intervention groups

	<i>Oral group</i>	<i>Feeding tube group</i>	<i>Supplement group</i>
Calories (kcal) pre	1310 ± 781	911 ± 753	1659.3 ± 745.7
Calories (kcal) post	1589 ± 582	1907 ± 507	1751.9 ± 542.0
% calories pre	55 ± 32	43.2 ± 29.9	78.6 ± 34.9
% calories post	66 ± 24	90.1 ± 27.5	84.5 ± 26.6
Proteins (g) pre	51.1 ± 30.4	35.1 ± 23.5	63.6 ± 34.9
Proteins (g) post	70.5 ± 28.8	77.0 ± 21.7	76.6 ± 27.4
% proteins pre	56.6 ± 34.5	41.5 ± 28.0	75.5 ± 44.8
% proteins post	77.8 ± 30.0	91.9 ± 29.0	106.0 ± 47.5

Pre = prior to intervention; post = after intervention

basis of alimentary anamnesis associated to 24-hour alimentary annotation.

The data were collected in domestic units and then converted into the corresponding grammage according to Soares and cols. (1991)<sup>24</sup> and the calculations were done using the software *Sistema de apoio à decisão em Nutrição* – [Nutrition decision-making Support] Version 2.5<sup>25</sup>.

The values obtained were compared with the recommendations for this group of patients, according to Kaminsky and Jeejeeboy, 1983<sup>26</sup> (40 kcal and 1.5 g protein/kg/weight/day).

The anthropometric indicators included: body weight and stature measurements, according to the methods of FRISANCHO (1990)<sup>27</sup>; Body Mass Index (WHO, 1997)<sup>28</sup>; triceps skinfold (FRISANCHO, 1990)<sup>27</sup>; midarm circumference measured with an inelastic tape (FRISANCHO, 1990)<sup>27</sup>; and midarm muscle area (FRISANCHO, 1981)<sup>29</sup>.

The laboratory indicators of serum albumin, total proteins, total lymphocytes count, hematocrit and hemoglobin were taken for all the patients in the initial and final evaluation.

### Nutritional intervention

The intervention was applied after alimentary anamnesis according to the patient's group:

#### *Oral group*

After tertiary alimentary anamnesis and individualized dietary orientation, the oral diet of each patient was adapted during the nutritional attendance according to their individual needs, in terms of consistency for a pureed food and fractioning into 5 to 6 meals a day.

#### *Feeding tube group*

The enteral diet was administered via nasoenteral feeding tubes with gastric placement when the accep-

tance of via oral alimentary diet was less than 2/3 of the nutritional recommendations

#### *Supplement group*

The oral diet was associated with alimentary supplement consisting of a powdered enteral diet to be reconstituted whenever the acceptance of oral diet was less than 75% of the nutritional recommendations.

### Statistical analysis

Kruskal-Wallis test<sup>36</sup> was applied for the variables of age, height, duration of nutritional therapy and radiotherapy, as well as for recommended proteins and calories. Analysis of the variables: appropriate percentage of calories and proteins; ingested calories and proteins, body mass index, muscular area of the arm, triceps skinfold; and laboratorial exams, we applied analysis of variance (ANOVA) according to NETER 1975<sup>30</sup> and Hartley's test to verify homogeneity of the variances and Tukey's HSD test<sup>30,31</sup> with correction for different sample sizes to verify differences between the groups ( $\alpha = 0.05$ ).

### Results

The three groups did not present differences in relation to age and height, duration of nutritional therapy and radiotherapy. The caloric ingestion increased in all three groups ( $p < 0.001$ ), as show in table II.

In relationship to the energy needs, a better adaptation was observed in the supply of calories following the nutritional intervention ( $p < 0.001$ ) (table I). However the greatest differential between the pre- and post-nutritional intervention values occurred in the feeding tube group ( $p < 0.05$ ).

The protein ingestion and adequação of proteic ingestion increased significantly in all three nutritional intervention groups. The largest differential between the pre- and post-intervention occurred in the feeding tube group ( $p < 0.05$ ), as shown in figure 1.

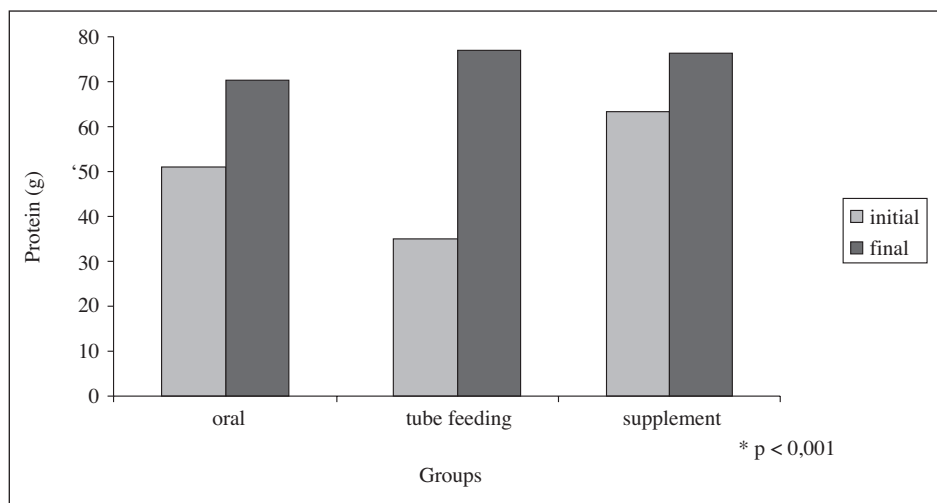


Fig. 1.—Initial and final values for ingestion of proteins (g) in the three nutritional intervention groups.

There was a significant increase in proteic ingestion by the three groups ( $p < 0.001$ ).

### Nutritional evaluation of the patients

The anthropometric indicators did not demonstrate a significant difference in the three groups during the treatment, with maintenance of the initial values.

There were no differences in the three groups between the serum values of albumin, total proteins, hematocrit and hemoglobin, with the exception of total lymphocytes, the values of which decreased significantly in all three groups after radiotherapy.

### Discussion

In the postoperative of patients with advanced head and neck cancer it was verified that patients with a weight loss  $\geq 10\%$ , six months prior to the surgery presented a higher risk for occurrence of postoperative complications<sup>37</sup>. When such patients are submitted to radiotherapy, three-year follow up has shown that the negative effects on survival are greater<sup>38</sup>.

In head and neck cancer, radiotherapy causes side effects such as xerostomia (59%) and odinophagy (44%) leading to limitation of oral ingestion<sup>39</sup>. Thus it is evident that oral feeding should be adapted in accordance with the individual characteristics of deglutition, age and side effects from the treatment<sup>20</sup>.

The patients designated for oral diet were counseled to follow a diet that was adapted during the nutritional attendance to their individual needs and to the side effects from radiotherapy. The characteristics considered were consistency in view of the tumor location, age, mastication conditions and fractioning to combat anorexia and to increase the caloric and proteic supply, as well as correction of alimentary habits.

In the present study, patients operated for head and neck cancer and submitted to radiotherapy maintained their weight in each of the three different nutritional

interventions. This finding is in agreement with PAGANO 2000<sup>32</sup>, who in a retrospective study on 32 patients with head and neck cancer submitted to radiotherapy with enteral home nutrition, verified that early caloric supply (39 kcal/kg weight) aids these patients to maintain body weight.

The results of the present research indicated a significant fall in the values of lymphocytes in the three study groups. This finding can be explained by the fact that radiotherapy can lead to a decrease of up to 30% in the number of lymphocytes persisting five years after terminating radiotherapy, due to the destruction of circulating lymphocytes that cross the radiation fields inside the blood and lymphatic vessels and that would be proportional to the blood flow in the irradiated areas<sup>33</sup>. In a study on breast cancer treated with radiotherapy, there also occurred significant lymphopenia.

In the present work, there was a significant increase in the caloric and proteic intake for the three groups, irrespective of the type of nutritional intervention. However McCarthy and cols. (1999)<sup>34</sup> in 40 patients submitted to radiotherapy divided into two groups, one with exclusively oral diet and the other with oral diet associated to alimentary supplement, verified that the latter group presented a significant increase in the caloric and proteic intake when compared to the other group, without however reducing the oral ingestion. In turn, Arnold and Richter<sup>34</sup>, in a study on 50 head and neck cancer patients submitted to radiotherapy, divided in two groups, one with exclusive oral diet and the other oral diet associated to alimentary supplement, also demonstrated that the group provided alimentary supplement presented an increase in the caloric and proteic intake. Similar results were found by NAYEL<sup>36</sup> and McCARTHY<sup>34</sup>.

This disagreement with the results of the present work can be explained by the fact that in the present study, the nutritional attendance was provided by a specialized nutritionist, also counting on the valuable contribution of a multidisciplinary team composed of

doctors, nurses, social workers and psychologists who had a great commitment with each individual patient.

In April 1991, the Nutrition and Dietary Division (NDD) of the Central Institute of the *Hospital das Clínicas* officially created the Program for Home Enteral Nutrition (PROSNED) with the objective of guaranteeing out-patients enteral nutritional therapy similar to that provided for hospitalized patients for recovery and/or maintenance of the nutritional state of the patient, with a 2.6 times cost reduction for the Institution<sup>23</sup>; the program enables optimization of hospital bed use; humanization of the service through family contact, maintenance of the patient's leisure activities and also whenever possible of work activity. This program highlights the benefits from supplying the patient free-of-charge out-patient attendance with industrialized enteral diets together with the equipment and material necessary for its use<sup>21, 22, 23</sup>.

## Conclusion

From the present work, it is possible to conclude that specialized nutritional intervention in patients with head and neck cancer submitted to radiotherapy can increase the caloric and proteic intake and maintain the anthropometric and laboratorial measurements. Adapting the nutritional intervention to the stage of the patient's disease and his or her initial oral ingestion enables selection of the best means of access to nurture the patient. The authors suggest that nutritional evaluation and dietary counseling are indicated on a routine basis for head and neck cancer patients under radiotherapy with the objective of preventing a deterioration in the nutritional state and anorexia associated with radiotherapy.

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