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RESEARCH ARTICLE

Nutritional support and parenteral nutrition in cancer patients: an expert consensus report

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Abstract
Background Malnutrition is a frequent medical problem of cancer patients that negatively impacts their quality of life.
Methods A multidisciplinary group of experts in Medical Oncology, Pharmacy, and Nutrition convened to discuss the management of the nutritional support in cancer patients.
Results Of the 18 questions addressed, 9 focused on nutritional support, 5 were related to parenteral nutrition (PN) and 4 about home PN (HPN). The panel of experts recommends using nutritional screening routinely, at diagnosis and throughout the disease course, for detecting the risk of malnutrition and, if it is positive, to perform a complete nutritional assessment, to diagnose malnutrition. Currently, there are different screening tools and methods that allow us to detect nutritional risk. Based on the evidence and experience, the panel stated that PN is indicated mainly when it is not possible to use the digestive tract and/or oral feeding and/or enteral nutrition is not sufficient or possible. The nutritional needs of the cancer patients, except in those cases where individualized measures are required, should be considered similar to healthy individuals (25–30 kcal/kg/day). The panel considers that the nutritional monitoring of the cancer patient should be multidisciplinary and adapted to the characteristics of each center. Additionally, the objective of the HPN is to improve or maintain the nutritional status of a patient at home.
Conclusions This document seeks to lay down a set of recommendations and to identify key issues that may be useful for the nutritional management of cancer patients.

Keywords Nutrition · Nutritional support · Enteral nutrition · Parenteral nutrition · Home parenteral nutrition · Cancer

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Introduction

Patients with cancer often have important nutritional deficiencies that significantly affect their quality of life. In fact, the proportion of patients who at the time of diagnosis present weight loss, ranges from 15 to 40% depending on the type of cancer. Additionally, the incidence of malnutrition increases as the disease progresses until it affects 80% of patients [1–3].

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Due to the improvement of all types of cancer treatments, although many cancers may still not be cured they may be converted to chronic diseases. In many cancer patients, however, all these treatments are hampered by the development of malnutrition and metabolic derangements, not only due to physical and metabolic effects of the cancer, but also due to the effects of anticancer therapies.

Malnutrition adversely affects the evolution of cancer patients, increasing the incidence of infections, length of hospital stay, and risk of death [3, 4].

However, the patient-centered information on the nutritional recommendations to be implemented is limited, so there is still a series of doubts regarding the nutritional management of the cancer patients in the clinical practice.

The publication of the new European Society for Clinical Nutrition and Metabolism (ESPEN) guidelines on nutrition in cancer patients [5] makes, from our point of view, necessary to reconsider the approach to the nutritional management of these patients. Additionally, it would be interesting to provide guidance to health care workers and patients on the most appropriate and effective management of nutritional and metabolic problems in cancer patients.

The aim of this manuscript is to analyze and respond to different issues related to the nutritional management of cancer patients and to establish consensus-based recommendations to provide the specialists in charge of the management of cancer patients with a frame of reference based on available scientific evidence and the clinical experience of the group.

Methods

A multidisciplinary group formed by specialists from the areas of medical oncology, pharmacy, and nutrition, working in collaboration, has developed a consensus report on different issues related to the nutritional management of cancer patients.

In the first meeting, performed on September 14, 2016, the panel selected and agreed a first list of topics related to the nutritional status of cancer patients. The different subjects that focused on the panel's attention were: (1) nutritional support in cancer patients; (2) parenteral nutrition (PN) in the oncologic patient; and (3) home parenteral nutrition (HPN) in oncological patients.

The Coordinating Committee developed a first list of topics that was distributed to all the experts. Subsequently, they evaluated the panel's comments and made the necessary modifications in a virtual meeting held in November 2016 in which the definitive list of questions was defined.

A PubMed literature search for English, French and Spanish language articles published to date was performed using the terms "malnutrition" OR "malnourishment" OR "parenteral nutrition" OR "home parenteral nutrition" AND "cancer". References cited in selected articles were also reviewed to identify additional relevant reports. Additionally, relevant published national and international guidelines were also scrutinized.

An initial document was drafted by the Coordinating Committee and it was reviewed by the expert panel members. The Coordinating Committee evaluated the panel's comments and modified the draft as they considered necessary. Subsequent revisions were based on feedback from the other authors until a consensus was achieved, and the final text was then validated (Fig. 1).

Results

1. What is the incidence of malnutrition according to the different types of neoplastic disease and oncological treatments?

The incidence varies according to the type of tumor and stage. By type of tumor, its prevalence is 86% in pancreatic cancer, 48–61% in lymphomas with poor prognosis and colorectal cancer, up to 46% in urological and pulmonary tumors; and 30–40% in good prognosis lymphoma, breast cancer, and sarcomas [3, 4].

By stage, malnutrition is present in up to 15–20% of initial stages, 80% in advanced disease and 80–90% in terminal patients [3, 4].

The Spanish study NUPAC [6], designed to determine the prevalence of malnutrition in advanced cancer, confirmed a 52% of moderate or severe malnutrition, 57.7% in esophageal cancer, 50% in gastric cancer, 47.1% in laryngeal, and 17.6% in prostate cancer. There was little awareness of the doctors involved and few patients had a nutritional diagnosis [6].

The PREDyCES® study found an association between malnutrition and disease, reactive emotional status, anorexia, complementary explorations, restrictive diets imposed by the disease, surgery, treatments with chemotherapy/radiotherapy and, finally, feeding. Malnutrition had an impact on hospital stay and costs, with an average stay of 3–4 days for malnourished patients compared to the well-nourished ones and an increase in costs associated with hospitalization of 20–25% [7].

2. How does the cancer influence the nutritional status of the patient?

There are multiple causes associated with malnutrition in cancer patients (Table 1). Among the different causes associated with malnourishment in cancer patients, those

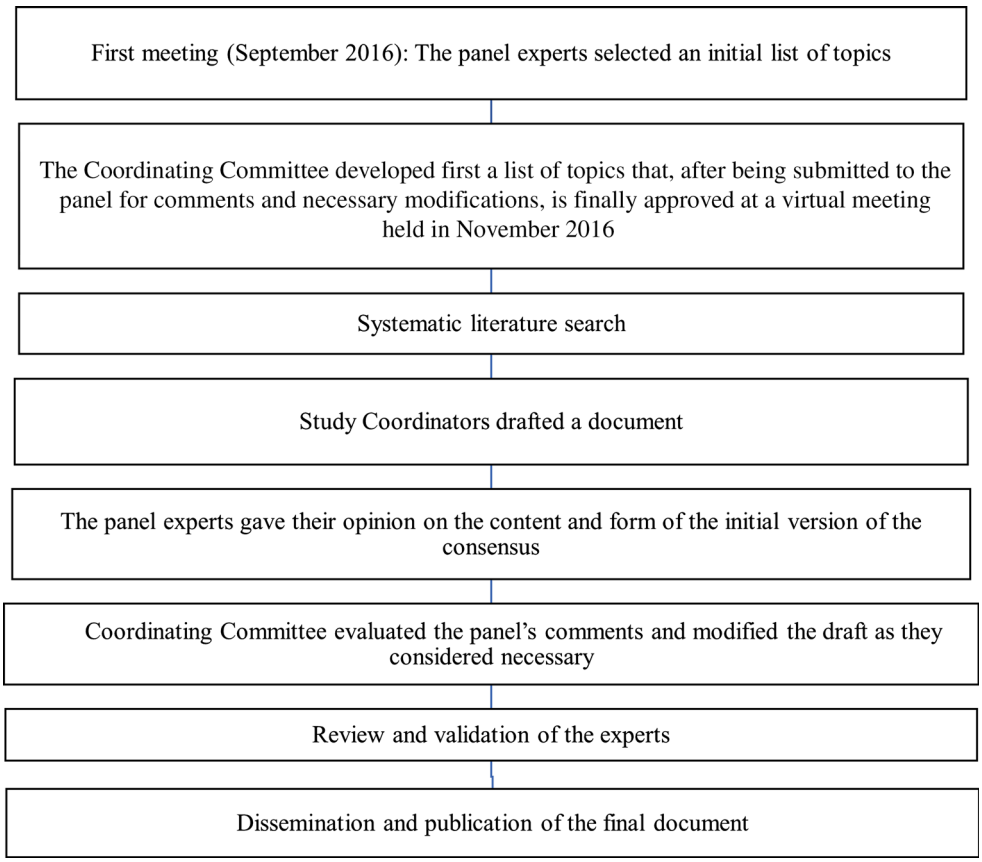

Fig. 1 Flow diagram of the consensus process

Table 1 Different causes associated with malnutrition in cancer patients

Causes associated with malnutrition	
Tumor	
a	Mechanical and functional alterations, especially in otorhinolaryngological and digestive tumors
b	The release of catabolic hormones, cytokines, and mobilizing factors that favor hypermetabolism and cachexia
Patient	
a	Personal habits, physical deterioration, anorexia, and psychological factors
Treatment	
a	Side effects of the surgery. Radiotherapy, chemotherapy, and immunotherapy. Mucositis, emesis, and diarrhea make intake difficult and favor malabsorption and loss of nutrients
Sanitary staff	
a	Lack of nutritional assessment, poor knowledge and training to detect malnutrition, delay in initiating adequate, and adequate enteral and parenteral nutrition
Health authorities	
a	Absence of a professional planning
b	Deficit in the Nutrition Units and Dietitians in the hospitals organigrams and in the Multidisciplinary Units that attends cancer patients in the public network, and that guarantee the appropriate nutritional assistance in these ones

related with the tumor (mechanical and functional alterations especially in otorhinolaryngological and digestive tumors), the patient (personal habits, physical deterioration, anorexia, and psychological factors), cancer treatment, and health authorities (deficit in the Nutrition Units and absence of a professional planning) should be highlighted.

3. How does the patient nutritional status influence the evolution of the oncological process?

Cancer cachexia is characterized by systemic inflammation, negative protein and energy balance, and an involuntary loss of lean body mass, with or without wasting of adipose tissue [8].

Multiple mechanisms are involved in the development of cachexia, including anorexia, decreased physical activity, decreased secretion of host anabolic hormones, and an altered host metabolic response with abnormalities in protein, lipid, and carbohydrate metabolism [9].

Cachexia associated with cancer produces: (a) deterioration of body image, functional status and quality of life, with a higher risk of toxicity from cancer treatments; (b) loss of muscle mass with risk of heart and respiratory failure, and decubitus ulcers; (c) delay in healing that favors fistulas and dehiscences; (d) deterioration of the immune system which favors infections and the decrease of digestive enzymes with risk of malabsorption [10]. In addition, cachexia and malnutrition have a negative prognostic impact and are associated with up to 30% of cancer deaths [1–3, 11, 12]. In terminal patients, the symptoms of anorexia, weight loss, xerostomia, and dysphagia were considered negative predictors of survival [1–3, 11, 12].

A multicenter retrospective review of the Eastern Cooperative Oncology Group (ECOG) found that a weight loss greater than 5%, prior to diagnosis and initiation of the cancer treatment, was predictive of early mortality regardless of stage, histology, and general condition [13].

Although the management of cancer cachexia has improved dramatically in the past decade, currently treatments for cancer cachexia are considered palliative; but new agents have improved patient survival as well as their quality of life [14].

4. How can we detect malnutrition in cancer patients?

A nutritional assessment is recommended for all cancer patients at diagnosis and during the treatment period in order to detect malnourished patients or at nutritional risk and to carry out an early intervention, since late diagnosis may make it difficult to recover and gain weight [15].

The first step for detecting malnutrition is by means the routine use of nutritional screening tools that they be linked to protocols of later action.

The ESPEN guidelines, published in 2017 [5], recommend periodically assessing nutrient intakes, changes in weight, and body mass index (BMI), from cancer diagnosis and repeat evaluation based on the stability of the clinical situation.

There are numerous nutritional screening tools; the most used would be: (1) for hospitalized patients: Nutritional Risk Screening 2002 (NRS 2002); (2) for the general population: the malnutrition universal screening tool (MUST); (3) for the elderly patient, the mini nutritional assessment (MNA) and the malnutrition screening tool (MST) have been validated in hospitalized patients and outpatients on chemotherapy and radiation therapy.

In the Multidisciplinary Clinical Guidelines on Nutrition Management of the Cancer Patient published in Spain in 2008 [16], in which development participated the SEOM (Spanish Society of Medical Oncology), SEOR (Spanish Society of Radiation Oncology), and SENPE (Spanish Society of enteral and parenteral nutrition), it was agreed to use MST as a nutritional screening for adult patients with cancer for its simplicity, reliability, and validity.

The MST is composed of two questions: one related to weight loss and the other one to intake/appetite. Patients were classified into two groups: at risk of malnutrition (score ≥ 2) and without risk of malnutrition (score < 2).

Once the risk of malnutrition is detected, a complete nutritional assessment is required.

In the cancer patient, the nutritional assessment considered as the "gold standard" is the VGA-GP (subjective global rating—generated by the patient). It should be performed by trained personnel, if there are nutrition units by a nutrition specialist and if there are none, by a well-trained professional. It takes into account weight loss, clinical history data such as diagnosis, current treatments, and medication taken, and analytical such as albumin and prealbumin. It also involves the patient himself who completes the part regarding the symptoms, the type of diet, and their daily activity. It requires a thorough physical examination for detecting decreased muscle mass, fat, and the presence of edema. This classifies the patient into: (a) normonutride, (b) at nutritional risk or moderate malnutrition, and (c) severe malnutrition.

5. What parameters (clinical, analytical, and anthropometric) should be taken into account to assess the initial and follow-up nutritional status of cancer patients?

There is no single parameter that tells us about nutritional status, but the combination of several ones (clinical, analytical, anthropometric, and functional).

Clinical parameters, such as the location of the tumor (there is a greater nutritional risk in the digestive tract cancer) and the treatment performed (greater risk with the use of concomitant treatments) have been identified.

In current symptomatology, the patient should be questioned about the current situation, detecting signs of nutritional risk that favor weight loss or impede the intake

and absorption of nutrients, such as anorexia, asthenia, decreased physical activity, nausea or emesis, diarrhea, steatorrhea or constipation, dysgeusia, pain, depression, or socioeconomic problems that hinder access to the food.

The ESPEN guidelines [5] recommend an assessment of muscle mass and fat reserves that can be performed by dual X-ray absorptiometry (DEXA) or bioimpedance analysis (BIA), as well as an assessment of physical performance using diverse scales as the ECOG, Karnofsky, dynamometria, speed of the March, etc. [5].

The analytical parameters most associated with nutritional status are albumin and prealbumin. However, they should be evaluated in the global context as they can be altered by other intercurrent and common problems in cancer patients (infections, liver diseases, renal, dehydration, anasarca, etc.).

The ESPEN guidelines recommend the use of serum C-reactive protein (CRP) and albumin to measure systemic inflammation [5].

Among the anthropometric parameters, significant weight loss $> 10\%$ for 6 months or a 5% during 3 ones is considered the most reliable indicator of nutritional deficit. Another accessible anthropometric indicator is the measurement of the brachial circumference (as a method to evaluate the loss of muscle mass) which, if it is < 20 cm or decreases > 2 cm between two determinations, suggests malnutrition. There are more precise tools that require specific equipment and are usually not available.

6. What are the objectives and indications of the different types of specialized nutritional support in cancer patients?

Nutritional support is classified according to its aggressiveness and complexity, and the following are included [5, 16, 17]:

(A) Nutritional recommendations and hygienic-dietary advice.
(B) Artificial nutrition:
    (a) Supplementation with oral enteral nutrition (ONS).
    (b) Enteral nutrition by tube.
    (c) PN.

The choice depends on the patient's current situation: oncological diagnosis, oncoespecific treatment, prognosis, nutritional status, nutritional requirements, and duration of nutritional support [5, 16, 17]. The nutritional support algorithm is shown in Fig. 2.

If oral food intake is insufficient despite nutritional counseling and ONS, it is recommended to initiate enteral nutrition, for which, according to the expected duration of support and patient situations, the type of tube and how to place it will be chosen [5, 16–18]. If the enteral supply is not sufficient or possible, the PN [5, 16, 17] will be indicated.

In cancer patients, nutritional support is indicated when there is malnutrition, the patient is not expected to be able to eat food for a week or more, or if their intake is less than 60% of their needs for more than 10 days (Grade of recommendation C) [5].

7. What are the nutritional requirements in cancer patients?

The energetic requirements of cancer patients, in principle, and if individualized measures (indirect calorimetry) are not performed, should be considered similar to those of healthy people (25–30 kcal/kg/day) [5].

It should be noted that this approach is often overestimated in obese people and underestimated in extremely thin ones, as well as some predictive equations such as Harris–Benedict.

Protein requirements should be between 1 (minimum) and 1.2–1.5 g/kg/day and if there is protein catabolism it could be increased to 2 g/kg/day [13]. In patients with acute or chronic renal failure, the protein supply should not exceed 1.0 or 1.2 g/kg/day, respectively. It is recommended a relationship between energy expenditure and nitrogen requirements between 130 and 100 kcal/g N [16, 17, 19].

The ideal lipid/carbohydrate ratio will be determined by the pathological history or clinical situation of each patient [19, 20]. It is advisable for this relationship to shift in favor of lipids provided there is insulin resistance, because of increased glucose oxidation and weight loss [20].

Another subject that need to be taken into account are the water and sodium needs of patients, which should be below normal (30 ml/kg/day for water and 1 mmol/kg/day for sodium) in the case of peritoneal carcinomatosis if there is obstruction or ascites for avoiding overload or third space [5].

Regarding other components, especially vitamins and trace elements, if there are no specific deficits it is not recommended to supplement in amounts higher than the recommended daily doses (RDD) [5].

8. Are there specific nutrients that influence the evolution of the oncologic process?

The specific nutrients or "Pharmaconutrients" are nutritional substrates that in addition to their nutritional value have other beneficial effects for the organism. They are used to modulate the course of the disease, for example, omega 3 fatty acids, arginine, or glutamine [5].

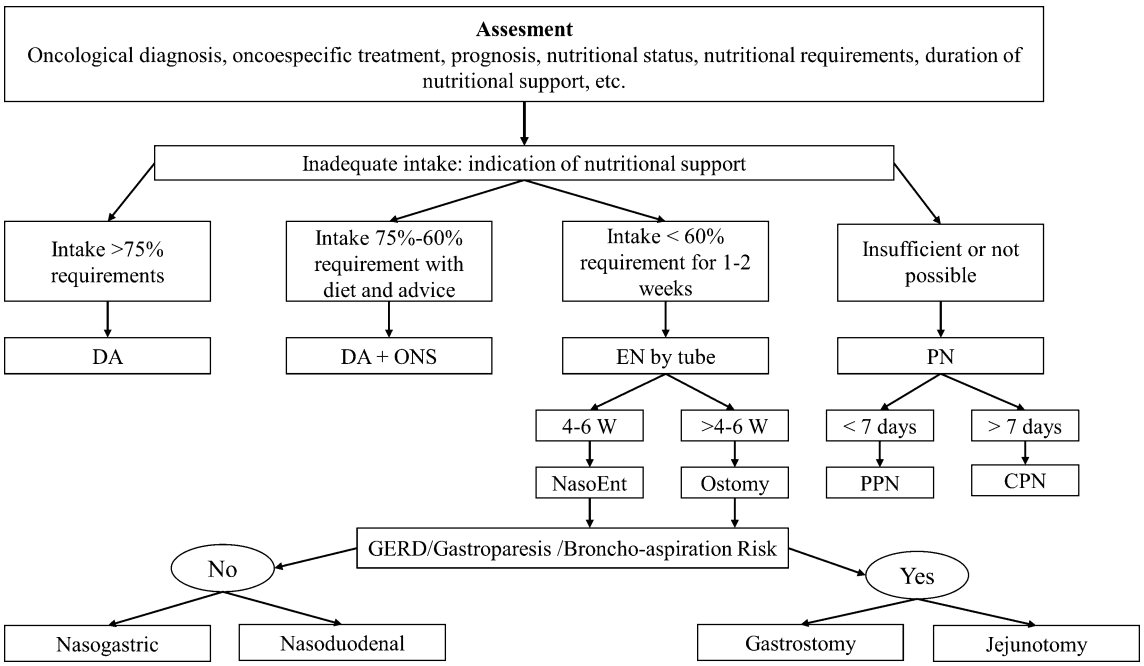

Fig. 2 Algorithm of nutritional support. Adapted from Hernández et al. [16]. *DA* dietetic advice, *ONS* oral nutritional supplements, *EN* enteral nutrition, *PN* parenteral nutrition, *W* weeks, *NasoEnt* nasoenteral, *PPN* peripheral parenteral nutrition, *CPN* central parenteral nutrition, *GERD* gastro esophageal reflux disease

Regarding specific protein nutrients, glutamine (oral and parenteral) is the most investigated in the last decades along with arginine, but there are few studies exclusively for cancer patients with inconclusive results [5, 17, 19, 20].

More recently, studies with HMB (hydroxy-methylbutyrate, leucine derivative), used as an anti-catabolic agent to curb protein degradation, have been published but, up to date, their results, do not recommend extending its use [5].

With lipids, although the benefits of omega-3 fatty acids compared to the omega-6 ones are biochemically known, because of the decrease in the pro-inflammatory activity, there are no clinical studies in oncology patients to prove this, except in the case of the perioperative cancer patients where the inflammatory response is much clearer, especially in head and neck cancer, and if the treatment is focused on the 5–7 days of the perioperative period [5, 17]. The formulas currently available in the market for these uses are often supplemented with both nucleotides and arginine.

The omega-3 fatty acid, derived from fish oil, eicosapentaenoic acid (EPA), has also been tested primarily as an anti-cachectic agent, although lack of treatment adherence is often associated with its presentation (capsules) [5].

Deficiency of vitamin D is observed in cancer patients [21] and this has been associated with cancer incidence and prognosis [22, 23]. Bolland et al. reported that vitamin D supplementation with or without calcium did not reduce skeletal or non-skeletal outcomes in unselected community-dwelling individuals by more than 15% [24]. Another recent systematic review arrived at a similar conclusion [25]. However, up to now, it is not known whether using vitamin D supplements to normalize vitamin D levels in states of deficiency will improve prognosis in cancer patients.

Radiotherapy of the pelvic region is associated with gastrointestinal symptoms in up to 80% of patients [26]. Some papers have reported on potential protective effects of oral probiotics, especially lactobacillus and bifidus species [27, 28]; though there is some indication for protective effects of probiotics, due to the heterogeneity of the data and the limited study quality, no recommendation can be made. Moreover, the safety of using probiotics needs to be reliably addressed, before these products can be recommended in immunocompromised patients.

9. When is parenteral nutrition indicated in a cancer patient?

The PN, as a specific nutritional support modality in the cancer patient, is indicated mainly when it is not possible to use the digestive tract and/or oral feeding and/or enteral nutrition is not sufficient or possible [5, 16–18, 29]:

(a) *By contraindication of access to the digestive tract* Before a perforation, intestinal obstruction, or chylothorax.

(b) *Because of the impossibility of access to the digestive tract* As occurs in high-throughput entero-cutaneous fistulas in which no tubes are available to place distally therefrom, in paralytic ileus, digestive hemorrhage, or insufficient absorptive surface due to cancer surgery broad.

(c) *Ineffective digestive tract* As in short bowel syndrome, high-throughput fistulas, and intestinal insufficiency due to radiation-induced enteritis.

(d) *For low oral and/or enteral intake* When less than 60% of the nutritional needs for more than 1–2 weeks and an improvement in the nutritional status and quality of life is foreseen, the complementary PN can be used.

In incurable/palliative patients, the nutritional support should be performed when the expected benefit outweighs the potential risk. When the estimated survival is greater than 1–3 months, and in case of intestinal insufficiency, PN can be offered, if the oral/enteral route is insufficient and there are expectations of improvement in the patient's quality of life and functionality and with an express desire of this one [5].

10. What are the indications of complementary parenteral nutrition in cancer patients?

The complementary PN, to an insufficient oral or enteral support, would be indicated in those cases in which a clear improvement in the nutritional status or quality of life of the cancer patient is foreshadowed [5, 17, 30].

The PN has not been shown to improve the nutritional status of the oncologic patient with anorexia and functioning intestinal tract and, therefore, priority should always be given to the digestive tract [5, 30]. However, complementary PN could be indicated in patients in whom 60% of their energy needs cannot be covered by the digestive tract during a period of 1 or 2 weeks [5].

The composition of the nutrition will depend on the necessary complementation in each patient [5, 30]. It may be necessary a complete supplementation or only with one of its usual components (volume, nitrogen, glucose, lipids, micronutrients). It can be made as a customized preparation in the pharmacy department of the Hospital or to use any existing commercial preparation.

When an adequate supply of nutrients can be made orally or enterally, it should not be carried out parenterally since, in this case, PN is not effective, but probably harmful (Grade of recommendation A). A complementary PN should be used when the enteral contribution is insufficient to cover the difference between the calculated needs and the oral/enteral intake (Grade of recommendation C). The PN is recommended in patients with mucositis or severe long-term radiation-induced enteritis (Grade of recommendation C) [31].

11. What are the different routes of administration of parenteral nutrition in cancer patients?

The routes of administration of PN in the cancer patient are the same as in the rest of the patients. The selection of the different routes available will depend on the time the support is required, frequency of use (intermittent or daily), activity and lifestyle of the patient, surgical history affecting the insertion zone, psychosocial characteristics, and patient's ability to care himself (Table 2).

The sealing with the antibiotic taurolidine may be effective in reducing the incidence of catheter-associated infection in at-risk patients.

The complementary PN may be performed peripherally or centrally by temporary or permanent catheters if a duration of more than 15 days is expected. The subcutaneous route may also be used in the case of supplementary serum or some micronutrient such as magnesium.

12. Who should/can perform the nutritional follow-up of the cancer patient (Nutrition department, oncologist, primary care physician, etc.)?

The nutritional monitoring of the cancer patient should be multidisciplinary and adapted to the specific characteristics of each center.

The nutritional screening should be included in the oncology patient routine care and should be easy to do for any member of the therapeutic team either by nursing or medical graduates [5].

A simple nutritional assessment with a rapid nutritional history, anthropometry including BMI, and a basic analytical determination that incorporates albumin levels, should be feasible for the oncologist. Ideally, the oncologist should have sufficient nutrition training to refer the patient at nutritional risk or already malnourished to the nutrition specialist.

In the hospital environment, there should be a close collaboration between the oncology department and the nutrition unit. The existence of a nutrition consultation in oncology is a desirable situation.

The outpatients should also have the assistance of the primary care physician to detect nutritional problems and refer them to the nutrition specialist when needed.

The follow-up of the cancer patient with HPN is also multidisciplinary and requires clinical and analytic reviews, initially monthly and then every 3 months by the nutritional unit, as well as periodic basic analytical checks by the primary care physician.

Table 2 Different routes of administration of parenteral nutrition in cancer patients Adapted from Derenski et al. [32]

Routes	Characteristics
Peripheric	It will be used if central access is not available and a short-term duration (less than 7–10 days) is expected. It is percutaneously inserted peripherally. It is inexpensive, simple to use, and with little incidence of infection associated with a catheter. The drawbacks are that the osmolarity of the mixture should not exceed 800 mOsm/L and should be rotated every 48–72 h by the incidence of phlebitis
Central	The choice will depend on the type of patient, the management, and the availability in each center. They can be of four types:
Central percutaneous catheter	Implanted by a physician in subclavian, jugular, or femoral is economical and easily replaceable. It is only used for short-term parenteral support, requires suture for fixation, and has a high incidence of catheter-associated infection
Peripherally inserted central catheter (PICC)	It has the advantage that it can be implanted by graduates in nursing. It admits any composition and osmolarity of the mixture. It can be somewhat more complicated handling for the patient with ulnar access in case of home support
(Hickman-type) tunneled	It is implanted in the subclavian or jugular vein in the operating room by vascular radiologists or surgeons and is simply extracted. The single light one is preferable as it minimizes the possibility of infection. It is easily manageable by the patient in case of home support so it is the most advisable in such cases. It has the cosmetic disadvantage that it is visible from the outside
Reservoir or port-a-cath	It consists of a subcutaneous reservoir or port that is radiopaque and usually made of titanium and a very resistant self-sealing silicone membrane. It is implanted in the subclavian or jugular in the operating room by vascular radiologists or surgeons, the body image is not altered since it is subcutaneous and also it lacks of external elements that can be damaged
	It is preferred in cancer patients who require repeated or continuous vascular access for the administration of chemotherapy, blood or medications. The disadvantage is that for the patient with home support needs a special needle called a gripper or hubber that must be changed weekly

13. When is the withdrawal of parenteral nutrition indicated in a cancer patient?

The withdrawal of the PN should take into account the scope of the objectives proposed in each case in addition to the following considerations:

(a) *Recovery of digestive tract functionality* The transition of nutritional therapy should be monitored by evaluating the functional digestive recovery that allows incorporating the nutritional care plan with enteral nutrition, oral supplementation and/or natural feeding [33]. The transition will be made progressively for which one will consider its tolerance and the coverage of requirements exclusively by the digestive route to be able to definitively withdraw the PN.

(b) *For serious associated complications* The appearance of an infection associated with a catheter or mechanical complications such as catheter rupture, obstruction, thrombosis, etc. which do not allow adequate venous access, although they are not complications of the PN itself, constitutes a limitation for its use as a measure of nutritional support and oblige to pose its withdrawal [34].

(c) *In premortem situation of the terminal patients in a PN program* In patients with advanced neoplastic disease, chronic intestinal failure, and life expectancy greater than 1–3 months, HPN can improve quality of life and prolong survival [35–38]. However, when the clinical situation of the patient worsens and the patient's death is imminent, the PN should be discontinued and comfort measures must be applied since nutritional support does not offer benefits in most cases [5, 39].

14. What are the objectives of home-based parenteral nutrition in a cancer patient?

According to ESPEN, the general objectives of the HPN in the oncology patient are: to maintain or improve nutritional intake, attenuate metabolic alterations, maintain or improve muscle mass and functional capacity, reduce treatment interruptions, and improve the quality of life of patients [5].

The specific objectives of HPN in cancer patients are to prevent and treat malnutrition and/or cachexia, improve adherence to scheduled oncologic treatment, reduce discontinuations, decrease adverse effects of treatment, and improve patients' quality of life. (Grade of recommendation C) [5, 31].

Before hospital discharge, it is recommended that patients should be metabolically stable, receive multi-disciplinary patient-centered training, written

recommendations, access to safe material resources necessary for HPN, physically and emotionally capable to manage it, and have an adequate environment in their homes (very weak level of evidence, strong degree of recommendation) [40, 41].

Also, for prescribing HPN, its expected duration should be longer than 4 weeks, the life expectancy longer than 3 months, and the patient must accept it by signing the informed consent; the family environment must be trained, prepared, and motivated to collaborate with the HPN management and there must be a minimum of hygienic conditions at home. As for the system, there must be a multidisciplinary team with experience in HPN and a home-based medical-nursing team [42].

15. What are the complications of home parenteral nutrition in cancer patients?

The complications associated with HPN may be the same as those that appear when the PN is prescribed in the short term, but there are other complications specifically related to prolonged PN administration. There are four large groups of complications including mechanical, infectious, metabolic, and psychosocial [43, 44] (Table 3).

16. What is the nutritional follow-up recommended in an oncology patient who receives home parenteral nutrition?

Patients with HPN require close and individualized follow-up, with the objective of evaluating the efficacy and safety of the treatment, as well as being able to detect and resolve the complications associated with this therapeutic strategy [48, 49].

This monitoring will be carried out by the team of professionals who have indicated the HPN, usually the Nutrition Unit of the reference Hospital, in coordination with the medical teams involved in the control of the patient evolution [50].

A daily control of clinical parameters such as temperature, diuresis, vomiting, deposition, oral ingestion, and catheter insertion point should be performed by the patient [48, 50].

According to ESPEN, an anthropometric and analytical evaluation that includes weight evolution, electrolytes, hepatic function, creatinine, glucose, triglycerides, blood count, iron, albumin, and CRP with a periodicity of 3 months in stable patients will be performed at each visit to the Nutrition Unit and every 1–2 months when there is clinical instability. It is also recommended to request a determination of trace elements and vitamins (A, D, E, B12, folic acid) every 6 months and measure the bone mineral density by DEXA once a year (grade of recommendation C) [44].

17. What sources of information exist to improve the knowledge about the relevance of the nutritional support in cancer patients?

There are many and various sources of information. Recently, an update of the Haynes Pyramid, one of the natural leaders of the Evidence-Based Medicine Working Group, has been published, which summarizes in five levels the information resources based on their usefulness and properties on the health care decision making process [51, 52].

It can serve as a guide, but taking into account that the higher you get the information more elaborate it will be and there is a greater risk of being less updated:

Table 3 Complications of home parenteral nutrition (HPN) in cancer patients Adapted from Cuerda Compés MC. [43] and Staun et al. [44]

Complications	
Mechanic	These complications are related to the placement and especially to the maintenance of the catheter. In the case of HPN, catheter occlusion and venous thrombosis should be noted for their frequency [45]
Infectious	They are the most frequently observed complications in patients with HPN, they are mainly bacteremia and/or sepsis associated with the catheter [46]
Metabolic	They can manifest acutely, as is the case of hyperglycemia/hypoglycemia, hydro electrolytic alterations, and feedback syndrome or as long-term complications as a consequence of the effects of TPN on liver and bone. Liver disease occurs in the form of steatosis, intrahepatic cholestasis, biliary mud, or cholelithiasis. To prevent this complication, ESPEN recommends not adding more than 1 g/kg of fat, adjusting the caloric intake and infusing the PN in a cyclical way (grade of recommendation B) [44]. Bone metabolic disease is characterized by the presence of osteomalacia, osteoporosis, pain, or bone fractures. The PN related factors such as hypercalciuria, aluminum toxicity, vitamin D deficiency, or toxicity and protein overload are implicated in this entity [44]
Psychosocial	The HPN can influence the patient's quality of life [47]

ESPEN European Society for Clinical Nutrition and Metabolism, *TPN* total parenteral nutrition, *PN* parenteral nutrition

(a) *Original studies* Published in indexed medical journals that are accessed directly through the databases (PubMed, EMBASE, WOS, etc.). There are approximately 194 oncology journals and 13 specific clinical nutrition journals. Examples of these are: Clinical Nutrition, Nutrition Clinical Practices, Parenteral Journal and Enteral Nutrition, Nutrition, etc.

(b) *Systematic reviews* It collects Systematic Reviews: Cochrane Library and other ones of high quality.

(c) *Systematically derived recommendations* Critical reviews of articles, newsletters, evaluation reports, etc.

(d) *Synthesized summaries for clinical reference* It includes evidence-based clinical practice guides with updated and critically reviewed topics. For example: Up To Date, Clinical Evidence, Dynamed, BMJ Best Practice.

(e) *Systems* Refers to Clinical Decision Support Systems.

Conclusions

In cancer patients, the alterations of the nutritional status are frequent and have a negative impact on the prognosis of the tumor process. The panel of experts recommends using nutritional screening routinely, at diagnosis and throughout the disease course, for detecting the risk of malnutrition and, if it is positive, to perform a complete nutritional assessment, to diagnose malnutrition.

Currently, there are different screening tools and methods that allow us to detect nutritional risk. The outpatient-validated and hospitalization screening method in the cancer patient is the MST. In addition, anthropometric parameters such as significant weight loss and analytical parameters, such as albumin assessed together with CRP, can provide information about the nutritional status.

Regarding the nutritional needs of the cancer patients, except in those cases where individualized measures are required, they should be considered similar to healthy individuals (25–30 kcal/kg/day).

In the oncologic patient, total PN is indicated when it is not possible to use the digestive tract and/or oral feeding and/or enteral nutrition is not sufficient or possible. Complementary PN to an insufficient oral or enteral support would be indicated when a clear improvement in the nutritional status or the quality of life of cancer patients is foreseen.

The panel considers that the nutritional monitoring of the cancer patient should be multidisciplinary and adapted to the characteristics of each center.

The objective of the HPN is to improve or maintain the patient's nutritional status at home and would be indicated in patients whose digestive system does not guarantee the nutrients necessary to cover their nutritional requirements.

The HPN requires periodic evaluation and knowledge in its technique and management.

This consensus highlights several key elements that help physicians to normalize the management of the nutritional status of cancer patients in clinical practice, establishing common guidelines for indication, monitoring, nutritional requirements, and access routes to PN.

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Compliance with ethical standards

Conflict of interest The authors declare that they have no conflict of interest.

Ethical approval This article does not contain any studies with human participants or animals performed by any of the authors.

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