

New trends in nutritional status assessment of cancer patients

A. ANDREOLI^{1,2}, A. DE LORENZO¹, F. CADEDDU³, L. IACOPINO¹, M. GRANDE³

¹Human Nutrition and ²Physiology, ³Department of Surgery PTV, "Tor Vergata" University, Rome (Italy)

Abstract. – Background: Nutritional status assessment and support should be considered a valuable measure within the overall oncology strategy. Despite extensive research in the field of clinical nutrition, definite guidelines to base rational nutritional assessment and support in cancer patients are still debated. This review examines different approaches to nutritional status in cancer patients.

Design: The assessment of nutritional status is usually based on anthropometric measures, biochemical or laboratory tests, clinical indicators and dietary assessment. At present, body composition (BC) is rarely measured in the clinical setting because it is thought to be too unmanageable and time-consuming. However, using new technologies, the estimation of fat, lean and body fluids, that is significant in the management of nutrition therapies in oncology, has become easy.

The present study evaluates the different methods of nutrition assessment today available, especially body composition (BC) measurements. Furthermore, nutrition assessment, relevance of nutritional support and choice of nutritional strategy, in surgical patients, are discussed.

Discussion: Given the clinical relevance of nutritional intervention in patients' quality of life, the nutritional status assessment has a key role in oncological and surgical practice and should include BC assessment in order to tailor nutritional treatment to patients' individual requirements. Furthermore, administration of the supplemented diet before and after surgery seemed to be the best strategy to reduce complications and length of hospital stay.

Key Words:

Nutritional status, Cancer, Malnutrition, Cancer cachexia, Body composition, DXA, BIA.

the body resulting from intake, absorption and utilization of nutrient and the influence of particular physiological and pathological status¹.

Cancer is one of the major causes of morbidity and mortality throughout the world. It is the second most frequent cause of death in Europe and it has becoming the leading cause of death in old age^{2,3}.

Weight loss and nutritional problems are often associated with cancer⁴. Extreme weight loss is commonly seen in patients with incurable solid cancer and, to date, it is hard to successfully manage it.

Despite extensive research in the field of clinical nutrition, certain guidelines to base rational nutritional assessment and support in malnourished patients are sparse.

Nutritional status is the balance between the intake of nutrients by an organism and the expenditure of these in growth, reproduction, and health maintenance process.

Given that this balance is highly complex and individualized, nutritional status assessment may be directed to several nutrition features. These aspects range from nutrient levels to products of their metabolism or functional processes regulated by these nutrients.

Nutritional status can be measured for individuals, as required in clinical practice, or for populations, as required in research field in order to identify populations at risk for nutrition impairment and to plan the interventions.

This review is focused on the techniques of nutritional status assessment and on their application in cancer patients both in medical and surgical practice.

Definition of Malnutrition and Cachexia

The definition of malnutrition and cachexia is still debated. Recently, Soeters et al (4) defined malnutrition as a subacute or chronic state of nu-

Introduction

The World Health Organization (WHO) defined the "nutritional status" as the condition of

trition in which a combination of varying degrees of over- or undernutrition and inflammatory activity have led to a change in body composition and an impairment in function.

Malnutrition and weight loss are common and may be due to several mechanisms including cancer and host response to tumour and anti-cancer therapies. Besides this, deficit of energy, protein and/or other nutrients, in malnourished patients, may cause measurable adverse effects on tissue/body form, composition, function and clinical outcome. Moreover, malnutrition has been associated to several clinical consequences, including quality of life impairment, decreased treatment response, high risk of chemotherapy-induced toxicity and survival reduction⁵⁻⁹. It may affect performance of organ systems and even the whole organism. Although many factors influence health status in cancer patients, nutrition may influence tumor biology, comorbidities and response to treatment. Besides, debilitating morbidities such as depression, fatigue and malaise may significantly impact on patient health.

In advanced cancer patients cachexia often occurs. Recently, Evans et al¹⁰ has given a new definition of cachexia: a complex metabolic syndrome associated with underlying illness and characterized by muscle loss with or without loss of fat mass. This multifactorial condition is associated with metabolic abnormalities, such as anorexia, early satiety and reduced food intake, depletion of lean body mass, muscle weakness, oedema, fatigue, impaired immune function and, finally, impairment of attention span and concentration.

Although poor nutritional status may adversely affect both prognosis and treatment tolerance, the evaluation of nutritional status in cancer patients has been often neglected. In spite of this, in day-to-day oncology practice, a sensitive but simply applied nutritional assessment is essential to identify high risk patients. The implementation of both screening and assessment tools is essential for effective nutritional intervention and management of cancer patients. Nutritional supplementation should be included in cancer therapeutic strategy, in order to improve both clinical outcomes and quality of life.

Several risk factors for malnutrition has been, such as major trauma, burns, sepsis, recent weight loss, gastrointestinal disorders and cancer. Additional information from medical history can also suggest further risk factors for malnutrition.

Several methods for assessing the nutritional status exist. However, none has been universally

accepted and, to date, there is no consensus on the best system¹¹. The deficiency of one gold standard measure has led researchers to develop several nutritional indices to stratify patients at increased risk for poor outcomes^{12,13}.

Traditionally, scoring systems have been based on objective measurements such as oral energy intake, body weight, weight loss, anthropometric data, total lymphocyte count, body composition analysis, creatinine–height index, hepatic secretory proteins and cell-mediated immunity. However, individual measurements of these objective parameters are not powerful enough to detect high risk malnourished patients¹¹.

The principal prognostic indices currently used are the Nutritional Risk Index (NRI) and the Maastricht Index (MI), which are based on mathematical equations; the Subjective Global Assessment (SGA) and Mini Nutritional Assessment (MNA) which are based on clinical and subjective assessments¹⁴⁻¹⁹.

Methods to Assess Nutritional Status

Nutritional status evaluation consists of baseline nutritional assessment, which includes food intake, anthropometric variables and laboratory parameters (biochemistry and biochemical); subjective global assessment; body composition measurements.

The identification of prognostic factors in cancer is relevant for the clinical management of the disease. Tumour stage remains the single most important prognostic factor in many advanced cancers. However, the assessment of nutritional status could be significant in therapeutic strategy.

The choice of nutritional status assessment method should take into account both the type of information required and the method validity and reliability.

The technique specificity refers to the ability to correctly classify normal individuals as having normal nutritional status. Body mass index BMI ($\text{wt}/[\text{ht}]^2$) is a global measure of nutritional status; nevertheless, there are several causes of low body mass index, including genetics and diseases. Thus, body mass index is not specific to nutritional status.

Clinical Assessment

Medical Record

Medical history discloses conditions resulting in increased metabolic needs, altered gastroin-

testinal function and absorptive capacity, chronic diseases, organ failure, and physical activity level. An evaluation of current medications may further elucidate risks of malnutrition.

A detailed diet history provides insight into a patient's baseline nutritional status and may detect subclinical nutrient deficiencies or toxicities. Assessment includes questions regarding chewing or swallowing problems, avoidance of eating related to abdominal pain, changes in appetite, taste, or intake, as well as use of a special diet or nutritional supplements.

Dietary Assessment

Several methods of collecting dietary data exist in order to estimate nutritional status. First of all, in the choice of a dietary assessment method, the type of data requested should be considered: is the research intended to document intake of "foods" or of "nutrients"? The most accurate dietary method is the record of foods consumed over the period of interest. This can be realized by individuals themselves or by observers. Daily phone interview, to record in detail previous day's intake (i.e. food type and amounts, preparation techniques, condiments) is the most effective and common technique. The data reported are converted from foods to nutrients using food composition tables. Given that estimating frequency of intake is thought to be based on cognitive processes, research has examined how to maximize reliability and validity of food frequency data by focusing on the cognitive tasks experienced completing a food frequency questionnaire. This food-frequency questionnaire has been already used by several Authors to assess the caloric intake²⁰.

Physical Examination

Physical examination should be focused on assessment of muscle mass and strength, evidence of chronic liver disease and signs of vitamin or mineral deficiency.

A systematic bedside subjective global assessment of nutritional status has been shown effective to classify patients in well nourished, moderately malnourished and severely malnourished.

Nutritional Index

Malnutrition includes two states: protein-energy undernutrition and protein undernutrition. Protein undernutrition is characterized by low serum albumin concentration, prevalence of edema and high frequency of acute infections. Ad-

vanced cachexia is usually evident at clinical evaluation, but important metabolic alterations in tumour-bearing patients with slight weight changes are frequently overlooked. Considering that several factors are involved in cancer-induced malnutrition, simple laboratory tests should be added to medical/dietary history and physical examination (dynamic weight loss, vitamin/mineral deficiency). Minimal baseline testing should include weight loss (>5%/month = severe) and serum albumin (<24 g/l = severe).

The Prognostic Nutritional Index (PNI)²¹, which includes serum parameters, immunity competence test and anthropometrics in absence of further dietary parameters, i.e. dynamic weight loss, has proved to be quite a reliable method to predict postoperative morbidity/mortality and to select cancer patients to aggressive preoperative nutritional interventions

In addition, two potential tools have been used: the Mini-Nutritional Assessment (MNA)^{20,22} and the scored Patient Generated Subjective Global Assessment (PGSGA)^{22,23}. The MNA is more simply applied and does not require a trained dietitian; the PGSGA has been previously validated in cancer patients¹⁰.

Two diffused scoring systems are the Nutritional Risk Index (NRI)^{24,25} and the Maastricht Index (MI)²⁶. The NRI is scored as follows: >100 indicates patient well nourished; 97.5 to 100 indicates mild malnourishment; 83.5 to 97.5 moderate malnourishment and <83.5 severe malnourishment. The usual weight is defined as the weight during 6 months or more before admission or before illness. The present weight is determined using a calibrated balance. The MI is based on serum albumin and prealbumin concentrations, the blood lymphocyte count and the percentage of ideal weight, which are used in the equation.

Cancer-Specific Screening and Assessment

Cancer cachexia requires specific methods of screening and assessment, which should take into account both the impact of the tumour and of the anticancer treatments on nutritional status. The patient-generated-subjective global assessment (PG-SGA) was developed specifically for patients with cancer^{27,28} and has been recognized as the standard for nutrition assessment for cancer patients by the Oncology Nutrition Dietetic Practice Group of the American Dietetic Association.

The functional capacity of the patient should be evaluated in conjunction with nutritional as-

assessment to ensure that the nutritional intervention is tailored to the patient. The Karnofsky Performance Status Scale (KPS)²⁹ is widely used to measure physical functioning as well as medical care requirements. However, it has been postulated that the KPS has some limitations in the assessment of clinical change over time³⁰.

The assessment of patient quality of life provides important data regarding the patient perception of health as well as information on the impact of malnutrition and on the effectiveness of nutritional support. The European Organisation for Research and Treatment of Cancer Core Quality of Life Questionnaire (EORTC QLQ-30) is a validated, reliable measure of quality of life in patients with cancer³¹. This method includes five functional scales (physical, role, emotional, cognitive and social), three symptom scales (fatigue, pain and emesis) and one global scale. Overall, these three scales produce a score between 0 and 100. Quality of life questionnaires cancer-specific have also been developed^{32,33}.

Anthropometric and Body Composition Measurements

Anthropometric approaches are, usually, relatively non-invasive methods that assess the individual size. For adults, body weight and height are used to evaluate overall nutritional status and to classify individuals as subjects with healthy or non-healthy weights. According the most recent classification, which is based on body mass index (BMI, kg/m²), a subject is normal at 18.5 to 25.0 kg/m², overweight at 25.0 to 29.9 kg/m², obese at over 30.0; and severe obese over 40 kg/m². Lower than 18.0 is undernourished.

Nevertheless, anthropometric measures of nutritional status can be compromised by several factors, such as the oedema, which is present in some forms of malnutrition and diseases and can increase body weight. Besides, body weight alone will often fail to demonstrate important disease- or therapy-related changes in caloric intake or metabolic rate.

Thomas³⁴ believes that the regulation of body composition is dynamic over time. Minute-to-minute composition is regulated by the individual metabolic state; further, day-to-day regulation depends on insulin and glucagon. Month-to-month regulation depends on hormones such as estrogens and androgens, growth hormone, prolactin, thyroid hormones, catecholamines, and corticosteroids regulate body composition. Immune mediators, such as interleukin-1 (IL-1), tu-

mour necrosis factor (TNF) and interleukin-2 (IL-2), can also affect body composition through modulation of appetite and food intake and through direct effects on skeletal muscle (35,36).

Actually, body composition is rarely measured in the clinical setting because it is thought to be too unwieldy and time-consuming. In spite of this, given the technological advances in body composition assessment (e.g., bioelectrical impedance analysis [BIA], dual energy X-ray absorptiometry [DXA], postassium-40 [⁴⁰K] counting), body composition can be determined more easily and its use in the clinical setting could enhance patient care.

The body can be divided into two or more compartments based on its anatomic, fluid, or chemical components. The most commonly used body composition model is a two-component model, in which the body is divided into fat mass and lean body mass (LBM) or Fat-Free Mass (FFM) including bone mass. The LBM compartment can be further divided into the extracellular mass (ECM) and body cell mass (BCM)³⁷. Extracellular water (ECW) and the structural bone matrix are the components that make up the ECM. BCM encompasses the intracellular water (ICW) compartment³⁸.

BCM includes fat-free mass portion of cells within muscle, viscera and the immune system and may be considered the functional most important compartment in determining energy expenditure, protein needs and the metabolic response to stress³⁹.

Body-fat mass is an important predictor of morbidity and mortality. Further, assessment of changes in body composition provide an objective method of evaluating the efficacy of therapeutic interventions designed to reduce health risks. In addition, accurate monitoring of fluid balance after surgery is a difficult task. Bioelectrical impedance analysis (BIA) is a safe and non-invasive method to measure extracellular water (ECW) and intracellular water (ICW) using a weak alternating current through the body. BIA is useful to detect small changes in body composition after gastroenterological surgery providing a method to assess perioperative water balance⁴⁰.

Bioelectrical Impedance Analysis (BIA)

Assessment of body composition (BC) plays an important role in nutritional status evaluation; bioelectrical impedance analysis (BIA), which has been known for more than 50 years, has become widely used in clinical settings during the last 10 years.

The utilize of BIA as a bedside method has been increasing, given that the equipment is portable and safe, the procedure is simple and non-invasive, the results are reproducible, rapidly obtained and accurate to assess BC^{41,42}.

The method, as described by Kyle et al⁴³, is based on the bioelectrical principle of impedance, i.e. the vector sum of resistance and reactance. Resistance is defined as the opposition to electrical current in relation to the length and diameter of a cylinder. The human body is similar to a set of serially connected cylinders (arms, trunk, and legs) with a known height and relatively constant diameter. As a result, height²/resistance is proportional to the hydrated part of the body, i.e. total body water plus lean body mass. The fat mass (the nonhydrated portion of the body) can be calculated subtracting the lean body mass from the weight.

Reactance reflects the impedance component resulting from the presence of capacitive elements, such as cell membranes. Bioelectric resistance is the opposition of a biological conductor to the flow of an alternating electric current; whereas capacitance is the resistive effect produced by tissue interfaces and cell membranes.

Capacitance causes a drop back of the current voltage, creating a phase shift. This shift is quantified geometrically as the angular transformation of the capacitance/resistance ratio, or phase angle⁴⁴.

Multifrequency bioelectrical impedance analysis is based on the principle that the body's resistance is dependent on the frequency of the applied alternating current. Total body water is distributed between intracellular compartment and extracellular spaces, which are separated by cell membranes. At a low frequency, cell membranes act as capacitors and the amount of extracellular water is predominantly measured. At a higher frequency, cell membranes become permeable and the total amount of body water can be measured. The ratio of extracellular water to total body water (edema index) is related to the resistance at a high frequency/ resistance at a low frequency ratio⁴⁵. Furthermore, the use of segmental bioelectrical impedance of arms and limbs leads to the precise evaluation of segmental body protein mass (muscle mass), as well as total body protein⁴².

Is it possible to use BIA in the assessment of cancer patients? And can phase angle be used as a nutritional and prognostic indicator in patients with other cancer types, such as breast, stomach,

and pancreatic and continue to be a predictor of survival after patients undergo definitive treatment for advanced cancer?

Several studies^{46,47} have been conducted on this way with good results. However, future trials are warranted.

Prognostic factor assessment is important to manage advanced cancer. Tumour stage remains the most important prognostic factor; however, other simply prognostic indexes are relevant.

Recently, Toso et al⁴⁶ stratified a patient cohort affected by advanced lung cancer according to BIA-derived phase angle score, a potential indicator of nutritional status. They observed that patients with a mean phase angle score up to 4.5 had a significantly shorter survival than patients with score higher than 4.5⁴⁶.

Subsequently, Gupta⁴⁸ investigated the efficacy of BIA-derived phase angle as survival prognostic factor in advanced colorectal cancer patients and demonstrated that phase angle is a strong survival predictor. Furthermore, Kiyama et al⁴⁹ assessed that multifrequency bioelectrical impedance analysis can be used to assess body composition and may be useful for performing nutritional assessments in patients previously submitted to gastrectomy.

Dual-energy X-Ray Absorptiometry (DXA)

The body composition (BC) measurement is relevant for clinicians, nutritionists and physiologists. The most common methods are based on a two-component model including FM and FFM, given the nutritional interest of the body amount of fat. For a long time, BC measurements have been regarded a gold standard of nutritional assessment in undernourished subjects⁵⁰ and several studies on impairment of body composition, based on a several methods, have been published⁵¹⁻⁵⁸.

Every technique has advantages and limitations. Recently, the DXA technique has become a gold standard due to its reproducibility and simplicity, particularly in repeated follow-up measurements.

DXA is now one of the most frequently used techniques for bone mineral density and body composition measurement as a result of the increasing worldwide availability of these scanners. The technique is attractive because it is non-invasive, easily applied for both healthy individuals and patients, and the radiation dose is extremely small. Scanning times as well as radiations have decreased substantially with new technologies.

A further attractive feature of the technique is the possibility of regional-body composition analysis. DXA is extremely precise for body fat, fat-free mass and bone mineral measurement and this has been well documented. Changes in the regional soft-tissue composition have been associated to different diseases.

In addition, DXA both for total regional BC is a more valid and precise method to assess BC. DXA divides the body into three components: bone, fat, fat-free and bone-free tissue⁵⁹.

At present, DXA machines are available in a large and increasing number of hospitals and research centres. This makes it an important tool not only for the assessment and management of osteoporosis, but also for studying how soft-tissue composition changes in health and disease.

Evaluation of Nutritional Status in Surgical Patients

Malnutrition in patients who are candidates for major surgery is a considerable problem for the surgeon because it represents a risk factor for postoperative morbidity and mortality^{60,61}

Moreover, cancer-bearing patients may have additional protein energy malnutrition secondary to cachexia. Thus, artificial nutritional support has been increasingly recognised as an essential part of perioperative care of malnourished surgical patients⁶².

Recently, the Consensus Conference of National Institutes of Health, American Society for Parenteral and Enteral Nutrition and American Society for Clinical Nutrition stated that malnourished patients are candidates for preoperative artificial nutritional support that could reduce the rate of postoperative complications by approximately 10%⁶³.

Despite extensive research in the field of clinical nutrition, definite guidelines to base rational preoperative nutritional assessment and support in surgical patients are lacking. Thus, it is still difficult for the clinician to decide which patients might benefit from nutritional support and to choose type and route of nutritional support^{60,62}

Nutritional Assessment

Quantifying mortality or morbidity related to malnutrition at an early stage during the hospital stay has a key role in surgical practice. There is currently no consensus on the best method for assessing the nutritional status of surgical patients^{60,61}.

De Jong et al¹⁵, in a randomized trial on 50 malnourished patients compared to a control group of 38 surgical patients, found that a combination of albumin, prealbumin, total lymphocyte count and the percentage of ideal weight was the most useful combination of nutritional tests with a sensitivity of 93% and a specificity of 94%. Subsequently, Detsky et al⁶⁴ evaluated five objective measurements (albumin, transferrin, delayed cutaneous hypersensitivity, anthropometry, creatinine-height index) together with the SGA and the prognostic nutritional index, in predicting nutritionally associated complications, in 59 surgical patients. The SGA was found to be the best index, with a sensitivity of 0.82 and specificity of 0.72. Differently, the Veterans Study³⁶, in a randomized trial on 395 malnourished patients candidates to major surgery, investigated the impact of perioperative total parenteral nutrition (PN) and found that the NRI was better than the SGA for determining which patients should receive perioperative total PN. Regarding elderly patients, Christensson et al⁶⁵ evaluated SGA e MNA to assess protein-energy malnutrition in 261 patients older than 65 years. The SGA was found to be a more useful tool to detect patients with established malnutrition, whereas the MNA was more effective to find out patients who required preventive nutritional measures. Similarly, Van Nes et al⁶⁶ evaluated nutritional status using the MNA in 1319 old patients and found that MNA poor nutritional status was associated with increased in-hospital mortality, longer hospital stay and higher rate of discharge to nursing homes.

Recently, Kuzu et al⁶⁷ prospectively assessed the nutritional status of a cohort of 460 surgical patients, using NRI, MI, SGA, and MNA scoring systems, in order to determine postoperative morbidity and mortality. Morbidity rates, especially severe infectious and non-infectious complications, were significantly higher in malnourished patients in all nutritional indices and the likelihood ratio was well correlated with the risk categories of every nutritional index. The Authors concluded that all nutritional assessment techniques are effective with no significant difference in predictive value; further, any of these techniques should be used to improve the outcome of surgical care.

Deterioration of Nutritional Status and Surgical Outcome

The negative impact of malnutrition on surgical outcome was long ago demonstrated.

In 1936, Studley⁶⁸ reported an increased postoperative mortality and morbidity in patients with a 20% weight loss. In eighties, Buzby et al²¹ found that malnutrition increases postoperative complications up to 46%. Moreover, Shao⁶⁰ observed that when 30%-40% of body weight is lost, the patient dies. Subsequently, in malnourished patients, Von Meyenfeldt et al⁷⁰ demonstrated a longer hospital stay, while Robinson et al⁷¹ found a two fold increase in costs. Recently, Correia and Waitzberg⁷², analyzing a cohort of 709 patients by a multivariate logistic regression model, found that malnutrition is an independent risk factor impacting on higher complications and increased mortality, length of hospital stay and costs.

Over the past decades several trials have shown that nutrition and immunocompetence are strictly related and malnutrition can impair all the immune functions⁷³.

Malnourished surgical patients have a greater susceptibility to infectious complications which, in combination with their illness, significantly increase postoperative morbidity and mortality⁷⁴. Physiologic stressors such as infection and surgical injury start a series of metabolic reactions that lead to a negative nitrogen balance. Although the initial metabolic event, mediated by cytokines, glucocorticoids, catecholamines, insulin, and insulin-like growth factors, is a protective response to injury, if time prolonged, it may become harmful to patients and lead to a catabolic state, if an adequate nutritional support is not available. In addition, malnutrition has detrimental effects on both cellular and humoral immunity⁷⁴.

In a recent study on 100 colorectal cancer patients surgically treated, Hatada and Miki⁷⁴ demonstrated that intense surgical stress is associated with higher postoperative mortality and morbidity rate in malnourished patients. They found, in malnourished patients, an elevated activation of the pro-inflammatory cytokine network associated with a decreased antagonistic reaction and an increased consumption of IL-6sR. Thus, a preoperative nutritional repletion and therapeutic use of IL-1ra might be useful for malnourished cancer patients⁷⁴.

Nutritional Requirements

One difficulty with nutritional support is accurately estimating the energy demands of the surgical patient to provide adequate substrate repletion. Approximately 40% to 80% of patients with cancer are clinically malnourished; this is further exacerbated by tumour biology and therapeutic

interventions. These patients require adequate supplies of exogenous substrates to meet energy and protein requirements and attenuate the catabolism of vital tissues. A minimum requirement of 25 to 30 kJ/kg per day is recommended for critically ill patients with carbohydrates comprising 60% to 70% of nonprotein calories and the remainder supplied by dietary fats, including 18-carbon precursors necessary for arachidonic acid synthesis. Protein allowance of 1.0 to 2.0 g/kg per day is also required and should include essential amino acids such as arginine and methionine. Finally, vitamin and electrolyte deficiencies such as vitamins C and A, vitamin E, and zinc should be corrected with supplementation, as clinically indicated^{75,76}.

Choose of Nutritional Route

Another key aspect of surgical nutritional support is the choice of enteral or parenteral route.

Enteral feeding is easily administered, well-tolerated, preserves the barrier mechanism of the gastrointestinal tract and promotes mucosal growth⁷⁴. Results of recent studies strongly suggest that in malnourished patients, postoperative enteral feeding should be preferred to parenteral nutrition^{62,73}. In fact, surgical patients fed enterally had an improved outcome compared with patients treated parenterally and the nutrition-related sanitary costs are substantially reduced when using the enteral route. In addition, immunonutrition enhances the host response, induces a switch from acute-phase to constitutive proteins and improves surgical outcome^{73,77}.

Recently, Gianotti et al⁷⁷, in a prospective randomized trial on 260 patients candidates to pancreaticoduodenectomy or gastrectomy for cancer, compared enteral, immunoenteral and total parenteral nutrition (TPN) and found that the immunonutrition group had a significantly better recovery of the immune postoperative parameters compared with the other groups.

Subsequently, Bozzetti et al⁷⁸ compared various types of nutritional support in a series of 1410 subjects submitted to surgery for gastrointestinal cancer and found that nutritional support, particularly immune-enhancing enteral nutrition, significantly reduced postoperative morbidity.

Nevertheless, it is not always safe to permit bowel absorption and certain clinical situations require an alternate access. In patients who cannot receive enteral support due to mechanical risks, like aspiration or functional deficits, and in

patients with hemodynamic instability or vasopressor therapy at risk of intestinal ischemia, the parenteral route is an available option.

Besides, an important factor in tolerance of enteral feeding is an effective gastric and bowel contractility. Abdominal bloating and distension, nausea, vomiting or high residual volumes reflect gastric contractility, while passage of flatus and stool shows colon contractility.

Perioperative total parenteral nutrition (TPN) has been associated to improvement of postoperative outcome in severely malnourished surgical patients; however, the available data do not support the use of TPN in elective gastrointestinal surgery in absence of malnutrition or systemic inflammatory response. Besides, its inappropriate use in unselected patients can increase the risk of complications (septic, non septic and related to parenteral nutrition) and incur unnecessary expenses⁷⁹.

Klein et al⁶³, in a recent review of 33 prospective, randomized, controlled trials including more than 2500 surgical patients, found that unselected use of early postoperative TPN in malnourished patients, who did not receive TPN preoperatively, increases postoperative complications by approximately 10%; besides, postoperative support is essential for patients unable to eat for extended periods of time.

Similarly, Planas et al⁷⁹ reported that the Nutritional Support Unit of his University Hospital adopted three criteria to start TPN in surgical cancer patients: pre-existing malnutrition, more than 7 days of postoperative fast, severely inflammatory response determined by fever, tachycardia, tachypnea, hyperglycaemia, leukocytosis, high level of C-reactive protein.

In a subsequent meta-analysis of 26 randomized trials (2211 patients) comparing TPN to standard care in surgical and critically ill patients, Heyland et al (80) detected that TPN had no effect on mortality (risk ratio (RR) 1.03; 95% confidence interval (CI), 0.81-1.31). Besides, TPN patients experienced less complications, but the difference was not statistically significant (RR, 0.84; 95% CI, 0.64-1.09). Complication rates were lower in studies that did not use lipids without difference in mortality. Studies limited to critically ill patients demonstrated a significant increase in complication and mortality rates compared with studies of surgical patients.

Immunonutrition in Surgical Patients

Several nutrients have been shown to influence immunologic and inflammatory responses in hu-

mans. Results of recent studies strongly suggest that administration of standard enteral diets supplemented with arginine, ω -3 fatty acids, glutamine, and other key nutritional substrates (immunonutrition) modulates immune and inflammatory responses and gut function and in elective surgical patients, immunonutrition is associated with a reduction in infectious complication rates and a shorter length of hospital stay without any adverse effect on mortality⁶².

Two meta-analyses showed that in surgical patients, postoperative use of immunonutrition improves the surgical outcome compared with standard formulas leading to reduction in hospital stay and infections^{81,82}.

Similarly, in a randomized trial on 196 malnourished surgical patients affected by gastrointestinal malignancy, Braga et al⁶² found that perioperative immunonutrition allows for shorter hospital stay and less complication rate.

In a recent systematic review⁸³ of twenty-two randomized trials with a total of 2419 surgical patients comparing the use of immunonutrition with standard enteral nutrition, immunonutrition was associated with lower infectious complications (RR, 0.66; 95% CI, 0.54-0.80). Moreover, nutrition with high arginine content was associated with a significant reduction in infectious complications and a trend toward a lower mortality rate compared with other immune-enhancing diets.

Psychological Distress and Surgical Outcome

The prevalence of psychiatric disorders in cancer patients assessed with a variety of instruments has been estimated to be between 25% and 60%⁸⁴.

Recent reports suggest that major depressive disorders occur quite frequently among patients with cancer⁸⁵. Unfortunately, the prevalence of depression among cancer patients is often underestimated, partly because many symptoms of depression, such as fatigue, weight loss, loss of appetite, or sleep disruption, closely mirror the physiological effects of cancer.

Previous Authors have investigated the relationships between psychological factors and cancer disease. Von Essen et al.⁸⁶ used the European Organization for Research and Treatment of Cancer questionnaire (EORTC-C30) and the Hospital Anxiety and Depression Scale (HADS) tests in a population of stomach and colon cancer patients to investigate the relationships between patient satisfaction with medical care, health-related

quality of life, and psychological function. The Authors concluded that satisfaction with mental care could affect psychological function. Kelsen et al.⁸⁷ investigated pain, depression, and QOL in patients with primary pancreatic cancer and concluded that pain and depression scores were lower than expected and that QOL negatively correlated with subjective pain scores. Portenoy et al.⁸⁸ reported that symptom prevalence in cancer patients was related to psychological state; thus, psychological factors such as depression and anxiety impact QOL must be carefully considered in the management of gastrointestinal cancer patients undergoing surgery.

Finally, Pasquini et al.⁸⁹ tested the feasibility of a multiphase screening protocol to detect and treat mood and anxiety disorders among cancer patients. In the initial screening phase an established self-report measure was used, whereas in the second phase the Structured Clinical Interview for DSM-IV (SCID-I), the Beck Depression Inventory (BDI), the Hamilton Anxiety Rating Scale (HARS), and a validated scale for the rapid dimensional assessment of psychopathology (SVARAD) were used by psychiatrists. Most patients were prescribed psychotropic medications and a significant reduction in both psychological and physical symptoms of depression and anxiety was observed.

Conclusions

In conclusion, the nutritional assessment, which leads to detection of malnourished patients or patients at risk of malnutrition, should be performed in every cancer patient.

Nutritional treatment should be started immediately after cancer diagnosis and continued during the treatment period and subsequently, until malnutrition signs or nutritional risk are present; this seems the best strategy to reduce complications and length of hospital stay. The impact of nutritional intervention is clinically relevant on quality of life, thus the nutritional assessment should be included in every anticancer strategy.

Ideal nutritional assessment techniques should have general applicability and should not necessitate disease specific equations. In order to determine the severity of malnutrition, an adequate definition of individual nutritional needs is warranted. Moreover, during nutritional therapy, monitoring of the changes in nutritional state is

also important because the loss of body fat may lead to functional alterations in health-related quality of life, even though fat stores are generally regarded only as energy reserves.

Accordingly, malnutrition in patients who are candidates for major surgery has been recognised a risk factor for both postoperative morbidity and mortality. Perioperative nutrition support, particularly immunonutrition, seems to be the best approach to support malnourished surgical patients and should be recognised an essential part of perioperative care.

References

- 1) WHO. Diet, nutrition and the prevention of chronic diseases. Report of a Joint WHO/FAO Expert Consultation. WHO Technical Report Series No. 916 World Health Organization: Geneva, 2003.
- 2) EUROPEAN COMMISSION HEALTH REPORT, 2001. http://europa.eu.int/comm/health/index_en.htm.
- 3) BOYLE P, FERLAY J. Cancer incidence and mortality in Europe, 2004. *Ann Oncol* 2005; 16: 481-488.
- 4) SOETERS PB, REIJVEN PL, VAN BOKHORST-DE VAN DER SCHUEREN MA, SCHOLS JM, HALFENS RJ, MEIJERS JM, VAN GEMERT WG. A rational approach to nutritional assessment. *Clin Nutr* 2008; 27: 706-716.
- 5) ANDREYEV HJ, NORMAN AR, OATES J, CUNNINGHAM D. Why do patients with weight loss have a worse outcome when undergoing chemotherapy for gastrointestinal malignancies? *Eur J Cancer* 1998; 34: 503-509.
- 6) DEWYS WD, BEGG C, LAVIN PT, BAND PR, BENNETT JM, BERTINO JR, COHEN MH, DOUGLASS HO Jr, ENGSTROM PF, EZDINLI EZ, HORTON J, JOHNSON GJ, MOERTEL CG, OKEN MM, PERLIA C, ROSENBAUM C, SILVERSTEIN MN, SKEEL RT, SPONZO RW, TORMEY DC. Prognostic effect of weight loss prior to chemotherapy in cancer patients. Eastern Cooperative Oncology Group. *Am J Med* 1980; 69: 491-497.
- 7) OVESEN L, HANNIBAL J, MORTENSEN EL. The interrelationship of weight loss, dietary intake, and quality of life in ambulatory patients with cancer of the lung, breast, and ovary. *Nutr Cancer* 1993; 19: 159-167.
- 8) LAVIANO A, MEGUID MM. Nutritional issues in cancer management. *Nutrition* 1996; 12: 358-371.
- 9) REY-FERRO M, CASTANO R, OROZCO O, SERNA A, MORENO A. Nutritional and immunologic evaluation of patients with gastric cancer before and after surgery. *Nutrition* 1997; 13: 878-881.
- 10) EVANS WJ, MORLEY JE, ARGILÉS J, BALES C, BARACOS V, GUTTRIDGE D, JATOI A, KALANTAR-ZADEH K, LOCHS H, MANTOVANI G. Cachexia: a new definition. *Clin Nutr* 2008; 27: 793-799.

- 11) READ JA, CROCKETT N, VOLKER DH, MACLENNAN P, CHOY ST, BEALE P, CLARKE SJ. Nutritional assessment in cancer: comparing the Mini-Nutritional Assessment (MNA) with the scored Patient-Generated Subjective Global Assessment (PGSGA). *Nutr Cancer* 2005; 53: 51-56.
- 12) JONES HJ, DE COSSART L. Risk scoring in surgical patients. *Br J Surg* 1999; 86: 149-157.
- 13) JONES JM. The methodology of nutritional screening and assessment tools. *J Hum Nutr Diet* 2002; 15: 1559-1571.
- 14) BAKER JP, DETSKY AS, WESSON DE, WOLMAN SL, STEWART S, WHITEWELL J, LANGER B, JEEJEEBHOY KN. Nutritional assessment: a comparison of clinical judgement and objective measurements. *N Engl J Med* 1982; 306: 969-972.
- 15) DE JONG PC, WESDORP RI, VOLOVICS A, ROUFFLART M, GREEP JM, SOETERS PB. The value of objective measurements to select patients who are malnourished. *Clin Nutr* 1985; 46: 61-66.
- 16) DETSKY AS, MCLAUGHLIN JR, BAKER JP, JOHNSTON N, WHITTAKER S, MENDELSON RA, JEEJEEBHOY KN. What is subjective global assessment of nutritional status? *J Parenter Enteral Nutr* 1987; 11: 8-13.
- 17) BUZBY GP, KNOX LS, CROSBY LO, EISENBERG JM, HAAK-ENSON CM, MCNEAL GE, PAGE CP, PETERSON OL, REINHARDT GF, WILLIFORD WO. Study protocol: a randomized clinical trial of total parenteral nutrition in malnourished surgical patients. *Am J Clin Nutr* 1988; 47: 366-381.
- 18) BUZBY GP, WILLIFORD WO, PETERSON OL, CROSBY LO, PAGE CP, REINHARDT GF, MULLEN JL. A randomized clinical trial of total parenteral nutrition in malnourished surgical patients: the rationale and impact of previous clinical trials and pilot study on protocol design. *Am J Clin Nutr* 1988; 47: 357-365.
- 19) GUIGOZ Y, VELLAS BJ. Malnutrition in the elderly: the mini nutritional assessment (MNA). *Band* 1997; 54: 345-350.
- 20) VICENNATI V, PASQUI F, CAVAZZA C, GARELLI S, CASADIO E, DI DALMAZI G, PAGOTTO U, PASQUALI R. Cortisol, energy intake, and food frequency in overweight/obese women. *Nutrition* 2010; Oct 8. [Epub ahead of print]
- 21) BUZBY GP, MULLEN JL, MATTHEWS DC, HOBBS CL, ROSATO EF. Prognostic nutritional index in gastrointestinal surgery. *Am J Surg* 1980; 139: 160-167.
- 22) DETSKY AS, MCLAUGHLIN JR, BAKER JP, JOHNSTON N, WHITTAKER S, MENDELSON RA, JEEJEEBHOY KN. What is subjective global assessment of nutritional status? *J Parenter Enteral Nutr* 1987; 11: 4-13.
- 23) BAKER JP, DETSKY AS, WESSON DE, WOLMAN SL, STEWART S, WHITEWELL J, LANGER B, JEEJEEBHOY KN. Nutritional assessment: a comparison of clinical judgement and objective measurements. *N Engl J Med* 1982; 30: 669-972.
- 24) BUZBY GP, KNOX LS, CROSBY LO, EISENBERG JM, HAAK-ENSON CM, MCNEAL GE, PAGE CP, PETERSON OL, REINHARDT GF, WILLIFORD WO. Study protocol: a randomized clinical trial of total parenteral nutrition in malnourished surgical patients. *Am J Clin Nutr* 1988; 47: 366-381.
- 25) BUZBY GP, WILLIFORD WO, PETERSON OL, CROSBY LO, PAGE CP, REINHARDT GF, MULLEN JL. A randomized clinical trial of total parenteral nutrition in malnourished surgical patients: the rationale and impact of previous clinical trials and pilot study on protocol design. *Am J Clin Nutr* 1988; 47: 357-365.
- 26) DE JONG PC, WESDORP RI, VOLOVICS A, ROUFFLART M, GREEP JM, SOETERS PB. The value of objective measurements to select patients who are malnourished. *Clin Nutr* 1985; 4: 61-66.
- 27) OTTERY FD. Rethinking nutritional support of the cancer patient: the new field of nutritional oncology. *Sem. Oncol* 1994; 21: 770-778.
- 28) OTTERY FD. Patient-Generated Subjective Global Assessment. In: *The Clinical Guide to Oncology Nutrition* ed. PD McCallum & CG Polisena, Chicago: The American Dietetic Association; 2000.
- 29) HWANG SS, SCOTT CB, CHANG VT, COGSWELL J, SRINIVAS S, KASIMIS B. Prediction of survival for advanced cancer patients by recursive partitioning analysis: Role of Karnofsky performance status, quality of life, and symptom distress. *Cancer Investigation*. 2004; 22: 678-687.
- 30) O'DELL MW, LUBECK DP, O'DRISCOLL P, MATSUNO S. Validity of the Karnofsky Performance Status in an HIV-infected sample. *J Acquir Immune Defic Syndr Hum Retrovirol* 1995; 10: 350-357.
- 31) ANDERSON RT, AARONSON NK, WILKIN D. Critical review of the international assessments of health-related quality of life. *Qual Life Res*. 1993; 2: 369-379.
- 32) KAPTEIN AA, MORITA S, SAKAMOTO J. Quality of life in gastric cancer. *World J Gastroenterol* 2005; 11: 3189-3196.
- 33) AVIS NE, SMITH KW, MCGRAW S, SMITH RG, PETRONIS VM, CARVER CS. Assessing quality of life in adult cancer survivors (QLACS). *Qual Life Res* 2005; 14: 1007-1023.
- 34) THOMAS DR. Loss of skeletal muscle mass in aging: examining the relationship of starvation, sarcopenia and cachexia. *Clin Nutr* 2007; 26: 389-399.
- 35) MORLEY JE, THOMAS DR, WILSON MM. Cachexia: pathophysiology and clinical relevance. *Am J Clin Nutr* 2006; 83: 735-743.
- 36) THE VETERANS AFFAIRS TOTAL PARENTERAL NUTRITION CO-OPERATIVE STUDY GROUP. Perioperative total parenteral nutrition in surgical patients. *N Engl J Med* 1991; 325: 525-532.
- 37) SHIZGAL HM. Nutritional assessment with body composition measurements by multiple isotope dilution. *Infusionstherapie* 1990; 17: 9-17.

- 38) EARTHMAN C, TRAUGHBER D, DOBRATZ J, HOWELL W. Bioimpedance spectroscopy for clinical assessment of fluid distribution and body cell mass. *Nutr Clin Prac* 2007; 22: 389-405.
- 39) ROUBENOFF R. The pathophysiology of wasting in the elderly. *J Nutr* 1999; 129: 256S-259S.
- 40) HANAKI N, ISHIKAWA M, NISHIOKA M, KASHIWAGI Y, MIKI H, MIYAKE H, TASHIRO S. Bioelectrical impedance analysis to assess changes in body water compartments after digestive surgery. *Hepatogastroenterology* 2006; 53: 723-729.
- 41) DE LORENZO A, ANDREOLI A, MATTHIE J, WITHERS P. Predicting body cell mass with bioimpedance by using theoretical methods: a technological review. *J Appl Physiol* 1997; 82: 1542-1558.
- 42) DE LORENZO A, ANDREOLI A. Segmental bioelectrical impedance analysis. *Curr Opin Clin Nutr Metab Care* 2003; 6: 551-555.
- 43) KYLE UG, BOSAEUS I, DE LORENZO AD, DEURENBERG P, ELIA M, GÓMEZ JM, HEITMANN BL, KENT-SMITH L, MELCHIOR JC, PIRLICH M, SCHARFETTER H, SCHOLS AM, PICHARD C. Composition of the ESPEN Working Group. Bioelectrical impedance analysis. part I: review of principles and methods. *Clin Nutr* 2004; 23: 1226-1243.
- 44) BAUMGARTNER RN, CHUMLEA WC, ROCHE AF. Bioelectric impedance phase angle and body composition. *Am J Clin Nutr* 1988; 48, 16-23.
- 45) CHA K, CHERTOW GM, GONZALEZ J, LAZARUS JM, WILMORE DW. Multifrequency bioelectrical impedance estimates the distribution of body water. *J Appl Physiol* 1995; 79: 1316-1319.
- 46) TOSO S, PICCOLI A, GUSELLA M, MENON D, BONONI A, CREPALDI G, FERRAZZI E. Altered tissue electric properties in lung cancer patients as detected by bioelectric impedance vector analysis. *Nutrition* 2000; 16: 120-124.
- 47) SARHILL N, MAHMOUD FA, CHRISTIE R, TAHIR A. Assessment of nutritional status and fluid deficits in advanced cancer. *Am J Hosp Palliat Care* 2003; 20: 465-473.
- 48) GUPTA D. Bioelectrical impedance phase angle in clinical practice: implications for prognosis in advanced colorectal cancer. *Am J Clin Nutr* 2004; 80: 1634-1638.
- 49) KIYAMA T, MIZUTANI T, OKUDA T, FUJITA I, A TOKUNAGA A, TAJIRI, T, BARBUL A. F.A.C.S. Postoperative changes in body composition after gastrectomy. *J Gastrointest Surg* 2005; 9: 313-319.
- 50) SHIZGAL HM. Body composition of patients with malnutrition and cancer. Summary of methods of assessment. *Cancer* 1985; 55: 250-253.
- 51) MATURO G, VESPASIANI G, MOHAMED EI, MAIOLO C, FINAZZI AGRÒ E, FORTE F, DE LORENZO A. Evaluating body composition of Italian prostate cancer patients without metastases. *Acta Diabetol* 2003; 40: S168-S170.
- 52) SEGAL RJ, REID RD, COURNEYA KS, MALONE SC, PARLIAMENT MB, SCOTT CG, VENNER PM, QUINNEY HA, JONES LW, D'ANGELO ME, WELLS GA. Resistance exercise in men receiving androgen deprivation therapy for prostate cancer. *J Clin Oncol* 2003; 21: 1653-1659.
- 53) SARHILL N, MAHMOUD F, WALSH D, NELSON KA, KOMURCU S, DAVIS M, LEGRAND S, ABDULLAH O, RYBICKI L. Evaluation of nutritional status in advanced metastatic cancer. *Support Care Cancer* 2003; 11: 652-659.
- 54) McMILLAN DC, PRESTON T, WATSON WS, SIMPSON JM, FEARON KC, SHENKIN A, BURNS HJ, McARDLE CS. Relationship between weight loss, reduction of body cell mass and inflammatory response in patients with cancer. *Br J Surg* 1994; 81: 1011-1014.
- 55) MOLEY JF, AAMODT R, RUMBLE W, KAYE W, NORTON JA. Body cell mass in cancer-bearing and anorexic patients. *J Parenter Enteral Nutr* 1987; 11: 219-222.
- 56) SMITH MR, FINKELSTEIN JS, MCGOVERN FJ, ZIETMAN AL, FALLON MA, SCHOENFELD DA, KANTOFF PW. Changes in body composition during androgen deprivation therapy for prostate cancer. *J Clin Endocrinol Metab* 2002; 87: 599-603.
- 57) KOCH J. The role of body composition measurements in wasting syndromes. *Semin Oncol* 1998; 25: 12-19.
- 58) COHN SH, ELLIS KJ, VARTSKY D, SAWITSKY A, GARTENHAUS W, YASUMURA S, VASWANI AN. Comparison of methods of estimating body fat in normal subjects and cancer patients. *Am J Clin Nutr* 1981; 34: 2839-2847.
- 59) PIETROBELLI A, FORMICA C, WANG Z, HEYMSFIELD SB. Dual-energy X-ray absorptiometry body composition model: review of physical concepts. *Am J Physiol* 1996; 271: 941-951.
- 60) DETSKY AS, BAKER JP, O'ROURKE K, JOHNSTON N, WHITWELL J, MENDELSON RA, JEEJEEBHOY KN. Predicting nutrition-associated complications for patients undergoing gastrointestinal surgery. *J Parenter Enteral Nutr* 1987; 11: 440-446.
- 61) NABER TH, SCHERMER T, DE BREE A, NUSTELING K, EGGINK L, KRUIJEL JW, BAKKEREN J, VAN HEEREVELD H, KATAN MB. Prevalence of malnutrition in nonsurgical hospitalized patients and its association with disease complications. *Am J Clin Nutr* 1997; 66: 1232-1239.
- 62) BRAGA M, GIANOTTI L, NESPOLI L, RADAELLI G, DI CARLO V. Nutritional approach in malnourished surgical patients. A prospective randomized study. *Arch Surg* 2002; 137: 174-180.
- 63) KLEIN S, KINNEY J, JEEJEEBHOY K, ALPERS D, HELLERSTEIN M, MURRAY M, TWOMEY P. Nutrition support in clinical practice: review of published data and recommendations for future research directions. Summary of a conference sponsored by the National Institutes of Health, American Society for Parenteral and Enteral Nutrition, and American Society for Clinical Nutrition. *Am J Clin Nutr* 1997; 66: 683-706.

- 64) DETSKY AS, BAKER JP, MENDELSON RA, WOLMAN SL, WESSON DE, JEEJEEBHOY KN. Evaluating the accuracy of nutritional assessment techniques applied to hospitalized patients: methodology and comparisons. *J Parenter Enteral Nutr* 1984; 8: 153-159.
- 65) CHRISTENSSON L, UNOSSON M, EK AC. Evaluation of nutritional assessment techniques in elderly people newly admitted to municipal care. *Eur J Clin Nutr* 2002; 56: 810-816.
- 66) VAN NES MC, HERRMANN FR, GOLD G, MICHEL JP, RIZZOLI R. Does the mini nutritional assessment predict hospitalization outcomes in elder people? *Age Ageing* 2001; 30: 221-226.
- 67) KUZU MA, TERZIOGLU H, GENÇ V, BULENT ERKEK, OZBAN M, SONYÜREK P, ELHAN AH, TORUN N. Pre-operative nutritional risk assessment in predicting postoperative outcome in patients undergoing major surgery. *World J Surg* 2006; 30: 378-390.
- 68) STUDLEY HO. Percentage of weight loss. A basic indicator of surgical risk in patient with chronic peptic ulcer *JAMA* 1936; 106: 458-460.
- 69) SHAO JZ AND YE MZ, GU JF. Parenteral nutrition. Shanghai: Shanghai Science and Technology Publishing House; 1984.
- 70) VON MEYENFELDT MF, MEIJERINK WJ, ROUFLART MM, BUILMAASSEN MT, SOETERS PB. Perioperative nutritional support: a randomised clinical trial. *Clin Nutr* 1992; 11: 180-186.
- 71) ROBINSON G, GOLDSTEIN M, LEVINE GM. Impact of nutritional status on DRG length of stay. *J Parenter Enteral Nutr* 1987; 11: 49-51.
- 72) CORREIA MI, WAITZBERG DL. The impact of malnutrition on morbidity, mortality, length of hospital stay and costs evaluated through a multivariate model analysis. *Clin Nutr* 2003; 22: 235-239.
- 73) WONG PW, ENRIQUEZ A, BARRERA R. Nutritional support in critically ill patients with cancer. *Crit Care Clin* 2001; 17: 743-767.
- 74) HATADA T, MIKI C. Nutritional status and postoperative cytokine response in colorectal cancer patients. *Cytokine* 2000; 12: 1331-1336.
- 75) GARREL DR, JOBIN, N, DE JONGE, LHM. Should we still use the Harris and Benedict equations? *Nutr Clin Pract* 1996; 11: 99-103.
- 76) LONG CL, SCHAFFEL N, GEIGER JW, SCHILLER WR, BLAKEMORE WS. Metabolic response to injury and illness: estimation of energy and protein needs from indirect calorimetry and nitrogen balance. *J Parenter Enteral Nutr* 1979; 3: 452-456.
- 77) GIANOTTI L, BRAGA M, VIGNALI A, BALZANO G, ZERBI A, BISAGNI P, DI CARLO V. Effect of route of delivery and formulation of postoperative nutritional support in patients undergoing major operations for malignant neoplasms. *Arch Surg* 1997; 132: 1222-1229.
- 78) BOZZETTI F, GIANOTTI L, BRAGA M, DI CARLO V, MARIANI L. Postoperative complications in gastrointestinal cancer patients: the joint role of the nutritional status and the nutritional support. *Clin Nutr* 2007; 26: 698-709.
- 79) PLANAS M, PEÑALVA A, BURGOS R, PUIGGRÓS C, PÉREZ-PORTABELLA C, ESPÍN E, ARMENGOL M, ROSSELLÓ J. Guidelines for colorectal cancer: effects on nutritional intervention *Clin Nutr* 2007; 26: 691-697.
- 80) HEYLAND DK, MACDONALD S, KEEFE L, DROVER JW. Total parenteral nutrition in critical ill patients. A meta-analysis. *JAMA* 1998; 280: 2013-2019.
- 81) BEALE RJ, BRYG DJ, BIHARI DJ. Immunonutrition in the critically ill: a systematic review of clinical outcome. *Crit Care Med* 1999; 27: 2799-2805.
- 82) HEYS SD, WALKER LG, SMITH I, EREMIN O. Enteral nutritional supplementation with key nutrients in patients with critical illness and cancer: a meta-analysis of randomized controlled clinical trials. *Ann Surg* 1999; 229: 467-477.
- 83) HEYLAND DK, NOVAK F, DROVER JW, MINTO J, XIANGYAO S, SUCHNER U. Should immunonutrition become routine in critically ill patients? A Systematic review of the evidence. *JAMA* 2001; 286: 944-953.
- 84) COSTANTINI M, MUSSO M, VITERBORI P, BONCI F, DEL MASTRO L, GARRONE O, VENTURINI M, MORASSO G. Detecting psychological distress in cancer patients: Validity of the Italian version of the Hospital Anxiety and Depression Scale. *Support Care Cancer* 1999; 7: 121-127.
- 85) PIRL WF, ROTH AJ. Diagnosis and treatment of depression in cancer patients. *Oncology* 1999; 3: 1293-1306.
- 86) VON ESSEN L, LARSSON G, OBERG K, SJODEN PO "Satisfaction with care": associations with health-related quality of life and psychosocial function among Swedish patients with endocrine gastrointestinal tumors. *Eur J Cancer Care* 2002; 11: 91-99.
- 87) KELSEN DP, PORTENOY RK, THALER HT, et al. Pain and depression in patients with newly diagnosed pancreas cancer. *J Clin Oncol* 1995; 13: 748-755.
- 88) PORTENOY RK, THALER HT, KORNBLITH AB, et al. Symptom prevalence, characteristics and distress in a cancer population. *Qual Life Res* 1994; 3: 183-189.
- 89) PASQUINI M, BIONDI M, COSTANTINI A, CAIROLI F, FERRARESE G, PICARDI A, STERNBERG C. Detection and treatment of depressive and anxiety disorders among cancer patients: feasibility and preliminary findings from a liaison service in an oncology division. *Depression Anxiety* 2006; 23: 441-448.

This review examines different approaches to nutritional status in cancer patients. The assessment of nutritional status is usually based on anthropometric measures, biochemical or laboratory tests, clinical indicators and dietary assessment. At present, body composition (BC) is rarely measured in the clinical setting because it is thought to be too unmanageable and time-consuming. However, using new technologies, the estimation of fat, lean and body fluids, that is significant in the management of nutrition therapies in oncology, has become easy. The present study evaluates the different methods of nutrition assessment today available, especially body composition (BC) measurements. Nutritional care is fundamental to cancer treatment (Davies M). Malnutrition specific to cancer patient populations has been observed to negatively impact patient's response to therapy; increase the incidence of treatment-related side effects; interrupt serial treatment regimens; extend hospital stay; impair muscle function, performance status, immune function, and quality of life; and ultimately affect survival [1-5].

Andreoli A, De Lorenzo A, Cadeddu F, Iacopino L, Grande M (2011) New trends in nutritional status assessment of cancer patients. *Eur Rev Med Pharmacol Sci* 15(5):469-480 PubMedGoogle Scholar. 83. Our aim was to assess nutritional status, QoL, and PS in hospitalised cancer patients recently initiated on PN for intestinal failure. (2) Methods: The design was a cross-sectional observational study.

(1) Background: Malnutrition in cancer patients impacts quality of life (QoL) and performance status (PS). When oral/enteral nutrition is not possible and patients develop intestinal failure, parenteral nutrition (PN) is indicated. There was a trend for patients with metastatic disease to have a lower BMI compared to patients with no metastatic disease, indicative of cancer cachexia [54]. MAC, HGS, and TSF were significantly correlated with weight and BMI on admission. HGS was moderately correlated with weight on admission and MAC. Background: Nutritional status assessment and support should be considered a valuable measure within the overall oncology strategy. Despite extensive research in the field of clinical nutrition, definite guidelines to base rational nutritional assessment and support in cancer patients are still debated. This review examines different approaches to nutritional status in cancer patients. Design: The assessment of nutritional status is usually based on anthropometric measures, biochemical or laboratory tests, clinical indicators and dietary assessment. At present, body composition (BC) is rarely measured in the clinical setting because it is thought to be too unmanageable and time-consuming. COSA: Head and neck cancer nutrition guidelines/Nutrition screening and assessment/How should nutritional status be assessed. In: Evidence-based practice guidelines for the nutritional management of adult patients with head and neck cancer. Sydney: Clinical Oncological Society of Australia.

The Evidence Based Practice Guidelines for Nutritional Management of Malnutrition in Adult Patients Across the Continuum of Care state that validated tools for your patient population should be used for assessment [1]. The scored Patient-Generated Subjective Global Assessment (PG-SGA) [2] and Subjective Global Assessment (SGA) [3] have been validated for use in the cancer population and are recommended in the Evidence.