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Diagnostic and management strategies of undernutrition in the elderly: a review

Diagnostic et stratégies de prise en charge de la dénutrition chez le sujet âgé : Revue de littérature

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Abstract Undernutrition is one of the major problems of public health, frequent in the extreme ages of life where its evaluation is often difficult. It most often leads to tissue loss with deleterious functional consequences. Aging is a persistent decline in the age-specific fitness components of an organism due to internal physiological deterioration. As a result of physiological changes, the nutritional status of the elderly can deteriorate rapidly and affect all steps of eating, from the sensation perceived when food is put into the mouth to the metabolism of nutrients. This can lead to protein-energy under-nutrition in this population. Anthropometric, biophysical and biological measurements allowing the quantification of undernutrition, the evaluation of its severity. This narrative review focuses on the importance of recognizing, preventing and treating under-nutrition in the elderly as part of management strategies in order to limit the morbid consequences in this vulnerable population.

Key words: *Undernutrition, Aging, Nutritional status, Elderly, Management*

Résumé La dénutrition est définie comme un apport insuffisant en énergie et en nutriments pour répondre aux besoins d'un individu afin de conserver une bonne santé. Ce déséquilibre entraîne des pertes tissulaires involontaires ayant des conséquences fonctionnelles délétères. Le vieillissement est un processus physiologique graduel et irréversible de modifications des structures et des fonctions de l'organisme résultant du passage du temps. L'état nutritionnel des personnes âgées peut se dégrader rapidement en raison des modifications physiologiques qui peuvent toucher toutes les étapes de l'alimentation, depuis la sensation perçue au moment de la mise en bouche des aliments jusqu'au métabolisme des nutriments. Cela peut entraîner une dénutrition protéino-énergétique chez cette population et engendrer de graves conséquences telles que la perte d'autonomie et l'aggravation des pathologies chroniques souvent associées au vieillissement. Un diagnostic précoce et une prise en charge adaptée permettent de prévenir les complications, limiter la dépendance des sujets âgés et réduire les coûts relatifs à cette pathologie.

Mots clés: *Dénutrition, Vieillissement, Etat nutritionnel, Sujet âgé, Prise en charge*

Introduction

According to the Algerian National Statistics Office (ONS), the average annual growth rate of the population aged 60 years has reached 2.5%, favored by the decline in mortality since 1963 and the improvement in health and socio-economic conditions. In 2019, people aged 60 and over represented 9.5% of the overall Algerian population crossing the threshold of 4 millions people for the first time, and that more than 55% of them have chronic diseases [1].

Aging is a physiological process involving biological, molecular and cellular changes that lead to a progressive decline in the body functions [1,2]. Aging is responsible for various concomitant pathologies such as cardiovascular and pulmonary diseases, neurodegenerative disorders, cancer, etc., involving metabolic and functional disorder [3]. These pathologies increase the undernutrition risk in the elderly by different mechanisms, ranging from food intake disorders to the consequences linked to these pathologies (polymedication, restrictive diets, decompensation of chronic diseases) [4]. This undernutrition can be aggravated in elderly subject by isolation, social exclusion, physical and psychological handicaps [5].

Several tools are available to assess undernutrition in this population, including anthropometric, biophysical and biological methods that allow better management and limit the risk of morbidity and mortality in elderly patients.

Definition and mechanisms of undernutrition

Definition

In the healthy elderly, energy requirements are comparable to those of adults and are estimated at 36 kcal/kg/d. Carbohydrates needs are 50 to 55% of total energy intake, fats 35 to 40% and proteins 10 to 15% [6]. Undernutrition occurs when there is a persistent inadequacy between the body metabolic needs and the bioavailability of energy and/or protein and/or micronutrients [7]. This imbalance between dietary intake and metabolic requirements results in involuntary tissue loss with deleterious functional consequences [8].

The World Health Organization (WHO) defines undernutrition as a body mass index (BMI) less than 18.5 kg/m^2. This threshold is also used by the Francophone Society of Clinical Nutrition and Metabolism (SFNCM), and the European Society of Clinical Nutrition and Metabolism (ESPEN) [7]. However, the BMI does not provide information about the proportion of lean body mass or fat mass and may present false positives in the case of constitutional thinness or false negatives in the case of amyotrophy masked by fat mass or in the case of associated edema [9].

Recently, experts representing several clinical nutriation societies with global reach have established the Global Leadership Initiative on Malnutrition (GLIM) consensus defining common phenotypic and etiological criteria for undernutrition in adults; if at least one phenotypic criterion and one etiological criterion are present in the same subject, the undernutrition diagnosis is retained [10] (**Table 1**).

Table 1. GLIM criteria for the diagnosis of undernutrition in adults

<table>
<tr><th colspan="3">Phenotypic Criteria</th></tr>
<tr><th>Weight loss (%)</th><th>Low body mass index (kg/m²)</th><th>Reduced muscle mass</th></tr>
<tr><td>>5% within past 6 months, or >10% beyond 6 months</td><td><20 if < 70 years, Or<22 if >70 years</td><td>Reduced by validated body composition measuring techniques</td></tr>
<tr><th colspan="3">Etiologic Criteria</th></tr>
<tr><th>Reduced food intake or assimilation</th><th colspan="2">Inflammation</th></tr>
<tr><td>50% of ER > 1 week, or any reduction for >2 weeks, or any chronic GI condition that adversely impacts food assimilation or absorption</td><td colspan="2">Acute disease/injuryd, for chronic disease-related</td></tr>
</table>

(adapted from [9]). GLIM: Global Leadership Initiative on Malnutrition. ER: Energy requirements, GI: Gastro-intestinal.

Mechanisms of undernutrition during aging

Undernutrition in the elderly is complex and multifactorial; it is usually the consequence of a food intake lack, an increase in metabolic needs, and physiological changes related to aging:

Lack of food intake

In the elderly, the decrease in food intake is often part of a particular social context that affects this population. The social and/or family isolation and the autonomy loss for the acts of daily life lead to an assistance loss for the organization of shopping and the preparation of meals, which may have an impact on the quality and quantity of consumed food. Thus, ignorance of nutritional needs, dietary errors when following diets prescribed for chronic pathologies (salt-free, low-calorie, cholesterol-lowering diets) and excessive drug consumption contribute to the reduction of nutritional intake [11].

Increase in metabolic needs

The pathologies that accompany aging (cancers, infections, chronic inflammatory states, etc.) are responsible for an increase in energy needs and hypercatabolism, most often associated with anorexia linked to the resulting anxiety. These metabolic changes are mainly due to the hyper-stimulation of monocytes and macrophages in order to fight against the different aggressions. This leads to an increase in circulating cytokines (interleukin-1 (IL-1), interleukin-6 (IL-6), tumor necrosis factor-α (TNF-α) which will orient the metabolism of the organism in order to provide the effect or cells (lymphocytes, phagocytes and fibroblasts) with the necessary nutrients by increasing the level of glucose (activation of hyperglycemic hormones), fatty acids (lipolysis) and amino acids (muscle proteolysis), responsible for the consumption of the body nutritional reserves [12]. These cytokines also have an anorectic effect, which further aggravates the intake deficiency and undernutrition [13].

Age-related physiological changes

Ageing is accompanied by several physiological changes that can have an impact on food intake. The oral and dental alterations that accompany the elderly, such as poor dental condition, poorly adapted appliances, dry mouth and altered gustatory and olfactory capacities, are responsible for a decrease in the pleasure of eating and therefore in food intake [14]. Swallowing disorders, reduction of digestive secretions (reduction of salivary secretions, of acid secretion by the atrophied gastric mucosa) and slowing of gastric emptying, secondary to aging, are other factors that play a role in the lack of food intake [15]. Psychiatric disorders (depressive syndromes and behavioral disorders) and dementia syndromes such as Alzheimer disease, which are common in aging, increase the elderly person disinterest in food [16].

Diagnosis of undernutrition in elderly

The overall assessment of the nutritional status, in the elderly, aims to identify the patients with a nutritional risk who may benefit from an assessment and an adapted nutritional intervention. No single test or parameter can reliably characterize nutritional status; diagnosis, and quantification of nutritional status usu -ally requires multiple measures constituting a combination of clinical, functional and biological elements.

Clinical examination

Nutrition history

Nutrition history can provide information on the existence of a recent change in diet or appetite, the notion of chronic and excessive consumption of alcohol, the presence of disgust or even food aversions. It also provides information about the patient psychological and intellectual state (mood, difficulties in concentration and memorization), the quality of sleep influencing energy expenditure and cooperation during food intake [17]. During the history, dietary intake can also be assessed by conducting a dietary survey using a variety of methods, including the 24-hour diet recall, the dietary self-questionnaire or food frequency and the dietary diary [18].

Physical examination

This reveals the clinical elements that suggest the diagnosis of undernutrition, such as disorders of the skin, repeated infections, delays in healing and vasomotor disorders of the extremities (acrocyanosis). The physical examination can also be used to look for muscle wasting (mainly in the quadriceps and deltoids) and oedema in favor of protein undernutrition [19].

Anthropometric measurements

Body weight: expresses the overall measurement of all body compartments (lean mass and fat mass). This is the simplest measurement to carry out: a scale is needed, or in particular cases where the patient cannot stand, a chair scale, or a weighing system coupled to the patient lift. The weight interpretation must take into account the height, age, morphotype of the subject, as well as the presence of oedema, dehydration or liquid effusion which could lead to interpretation errors. Weight is preferably measured in the morning, fasting, with an empty bladder and scantily clad. Daily weight fluctuations of about 1-1.5 kg are usually observed in a 60-70 kg adult. Taken in isolation, weight is not very informative for the diagnosis of undernutrition [20].

Height: is measured with a height gauge, ideally in an upright position (standing), without shoes, with joined heels. Its measurement can sometimes be difficult in elderly subjects who are bedridden or who have significant axial skeletal deformities (kyphosis or scoliosis). In this case, height is estimated by measuring the knee height (KH) using a pediatric height gauge placed under the foot with the mobile part resting on the knee bent at 90° at the level of the con -dyles, using the Chumlea equation [21]:

For women: Height (cm) = 84.88 - 0.24 x age (year) + 1.83 x KH (cm).

For men: Height (cm) = 64.9 - 0.4 x age (year) + 2.03 x KH (cm).

Body mass index (BMI): is the ratio of weight (kg) to height squared (m^2); it allows comparison of weight between subjects of different stature. Its limits of normality according to the WHO are between 18.5 and 24.9, without distinction between the sexes, except in a subject over 70 years of age where a BMI of less than 22 kg/m² is in favor of undernutrition according to the new GLIM criteria [9], because adiposity increases with age and can mask the pathological reduction of lean body mass, which is the sign of undernutrition. It is a simple tool but lacks specificity because it does not distinguish between lean and fat mass, and does not take into account the existence of hydrosodic retention.

Measurement of skin folds: this technique allows the evaluation of body fat mass. Its use in the assessment of nutritional status is based on the assumption that there is a constant relationship between total body fat and the thickness of subcutaneous fat measured at specific locations. The most frequently measured folds are the tricipital fold (TF) and the subscapular fold (SSF). The values are expressed in millimeters. The measurement is done with a fold forceps or Harpenden forceps by pulling the fold between the thumb and middle finger to grasp only the skin and subcutaneous fat, excluding the muscle. The TF is measured vertically on an arm at rest at the side of the body, halfway between the acromion and the olecranon, opposite the muscle mass of the triceps, and the SSF is measured one centimeter below the lower angle of the scapula, following the natural fold of the skin along a 45° axis [22].

The reference values for TF are 11.5±1.5mm in men and 17.5±1.5mm in women. In case of malnutrition, the values are 60 to 80% of the norms or even <60% in case of severe undernutrition [21].

Measurement of circumferences : The brachial circumference (BC) and the calf circumference (CC) estimate the muscle mass, the main component of the lean mass. The measurement is made with a non-elastic tape measure held in a horizontal position touching the skin around the limb being measured without compressing the underlying tissue. The BC is measured halfway between the acro -mion and the olecranon, at the same point where the TF is measured. From the BC and TF, we can determine the brachial muscle circumference BMC, representative of the lean mass, according to the formula: BMC (mm) = BC (mm) - [3.14 x TF(mm)]

The normal value of the BMC is 25±1 cm in men and 21.5±1 cm in women. Its value will be between 60 and 80% of normal in moderate undernutrition and <60% in severe undernutrition [23].

Instrumental methods

Bioelectrical impedancemetry: is a rapidly expanding method of body composition analysis that allows punctual detection of undernutrition, and precise determination of the body compartments of an individual and their evolution. Impedance corresponds to the resistance offered by a tissue (biological conductor) to the passage of a low intensity alternating current [24]. The impedance of a body is a function of the volume of water it contains. In the human body, the lean body mass, due to the electrolytes dissolved in water, is a good conductor of electricity compared to the fat mass [25]. The concept is to measure body water and deduce the amount of non-fat mass, assuming a constant hydration factor (usually 73%, hence: lean mass = total water/0.73). The fat mass is obtained by difference with the body weight [25].

Different bioelectrical impedancemetry devices exist and vary according to the type and number of electrodes but also the frequency used. In practice, most often, the low-intensity 800 µAmp current with an average frequency of 50 kHz, which is supposed to penetrate the entire water sector, is applied via superficial electrodes placed at the wrist and ankle of the homolateral foot [26]. The parameters calculated by bioelectrical impedancemetry are mainly: lean mass LM (or free fat mass FFM), fat mass FM, total body water TBW, basal metabolic rate BMR, estimated needs EN, lean mass index LI (LM(kg)/

height²) and fat mass index FMI (FM (kg)/height²). Body composition values can then be interpreted either on the basis of absolute values, which allows longitudinal follow-up of the same patient, or on the basis of percentiles, which allows comparison with the body composition of subjects of the same age and sex, below the 10 percentile are strongly associated with undernutrition [27,28]. Thus, measurement of LM by bioelectrical impedancemetry is a sensitive parameter for the diagnosis of undernutrition [29].

Dual energy X-ray absorptiometry (DEXA): Initially used to quantify bone mineral density, and is currently used as a reference technique to assess body composition. It has excellent accuracy and allows segmental analysis of body composition (trunk, limbs) [30]. It consists in scanning the human body with X-rays of two different energies. These undergo attenuation depending on the material they pass through. The intensity of the X-rays after passing through the human body is measured by detectors and then converted into bone mass and soft tissue for each pixel. The use of two different energy levels allows firstly to separate the bone mass from the soft tissues, and secondly to individualize the fat mass and the lean mass within the soft tissues. It is therefore a three-compartment method [22,26]. The limitations of this technique are the cost and the scarcity of equipment.

Biological markers

Biological parameters of nutritional status are part of the means of diagnosing undernutrition and monitoring its evolution. They are mainly based on the measurement of nutritional proteins (albumin and transthyretin). Nevertheless, no parameter evaluating the nutritional status is very specific.

Serum albumin: is the most often used marker for the diagnosis and monitoring of undernutrition; it is the most important serum protein, representing about 60% of circulating proteins, with usual values between 38 and 48g/L. It plays the role of transporting several substances (hormones, free fatty acids, bilirubin, drugs, etc.), and of maintaining oncotic pressure. It is synthesized by the liver without being stored there, then released into the vascular sector before migrating into the interstitial space (60% of total albumin), but it is also provided by certain foods such as milk and eggs [31]. In inflammatory syndromes, the albumin flow to the interstitial sector increases under the influence of pro-inflammatory cytokines, leading to hypoalbuminemia and edema formation [32,33]. For this reason, it is recommended that the albumin level be interpreted according to the patient inflammatory state, as assessed by the C-reactive protein (CRP) level. Recommendations for the undernutrition management strategy in the elderly, give the figures of <35g/L for the undernutrition diagnosis, and <30 g/L for severe undernutrition [31].

Composite indices are calculated to assess the complications of undernutrition based on albumin levels and weight variation in relation to the ideal weight for the elderly, in particular the geriatric nutritional risk index (GNRI) for the over 70 years old [34]:

GNRI: [1,489 x serum albumin (g/L)] + [41.7 x (current body weight/ideal body weight)]

According to the GNRI, patients can be classified into three categories: > 97.5% (minimally undernourished, low risk of complications), between 83.5% and 97.5% (moderately undernourished, medium risk of complications), < 83.5% (highly undernourished, high risk of complications).

Serum prealbumin or transthyretin*:* is a carrier protein for retinol or vitamin A (Retinol binding protein RBP) and thyroid hormones, synthesized by the liver. Its usual values are between 0.20 and 0.40g/L. Because of its specificity and short half-life (48h), transthyretin is considered as a good marker of nutritional status, in particular for early diagnosis of subclinical undernu-trition and for monitoring nutritional management [35]. A value < 0.16g/L indicates undernutrition and a concentration below 0.10g/L severe undernutrition, which should always be interpreted in relation to the CRP, essentially during hypercatabolic situations, in order to determine whether the decrease origin in transthyretin is purely nutritional or both nutritional and inflammatory [31].

Transferrin: is a protein that transports iron and several trace elements (zinc, copper, manganese) in the bloodstream and distributes them to the cells; its synthesis in the liver is inversely proportional to the amount of iron in the cell. Its half-life is 8 days, with a usual value of 2 to 4 g/L. If there is no iron deficiency as indicated by a normal ferritin concentration, a decrease in transferrin indicates undernutrition. If there is iron deficiency, as manifested by a hypochromic microcytic anemia and/or a decrease in ferritin levels, the variation in transferrin levels is no longer interpretable in the assessment of protein undernutrition because it lacks specificity and its level may vary in several pathophysiological situations independently of the nutritional status [31].

Nitrogen balance : allows to follow the effectiveness of the nutritional management and to adapt the nitro-gen contributions to the needs for the aged subjects. It represents the difference between the nitrogen ingested (ingesta) and the nitrogen eliminated (excre-ta) by the organism expressed in grams of nitrogen per 24 hours (g N/24h) [36].
The evaluation of the nitrogen ingested amount implies the knowledge of the protein content of each feed and the amount absorbed and then converting the ingested protein into nitrogen (on average 1g of animal protein contains 0.16 g N) [37]. Nitrogen losses are mainly urinary (85-90%), and small proportions are faecal (less than 10%), as there are other ways of elimination in a so-called insensitive form (sweat, skin desquamation, phaneras...). Urinary nitrogen is mainly in the form of urea (75-85%) and the rest in the form of ammonia, creatinine and free amino acids.As a general rule, a positive nitrogen balance (ingested nitrogen > eliminated nitrogen) reflects an anabolic state while a negative balance (ingested nitrogen < eliminated nitrogen) reflects a catabolic state [31].

Blood and urine Creatinine: Creatinine is the end product of creatine and phosphocreatine during muscle catabolism before being eliminated in the urine. There is a relationship between muscle mass and 24-hour urine Creatinine (1g of creatinine excreted corresponds to 21.8 kg of muscle in a healthy adult) according to the following two equations [38]:
Lean mass (kg) = 21.8 x 24 h urine Creatinine (g/24h).
On the other hand, the measurement of urine creatinine is not widely used because it depends essentially on renal function and requires the collection of 24-hour urine and a diet free of creatinine because the urinary excretion of creatinine varies according to meat intake. The blood concentration of creatinine depends as much on the muscle mass as on the renal function [39].

Nutritional scores

Nutritional scores are composite scores combining different clinical, anthropometric and biological markers in order to improve their sensitivity and specificity.
Mini Nutritional Assessment (MNA) : is a questionnaire specifically developed for undernutrition screening in the elderly. It explores appetite, dependence, lifestyle and diet. It includes at least the search for situations at risk of undernu-trition. It is a score that is initially established in a detailed form with a screening component (6 items) and a global evaluation component (12 items) [40]. As its implementation is considered too time-consu-ming, a short form is developed (MNA-SF) with only 6 items, it classifies subjects into: adequate nutritional status (score>11), risk of undernutrition (score < 8-11 points), and undernutrition status (score < 0-7 points) [41]. This score has a sensitivity of 96%, specificity of 98%, and predictive value of 97% [42].

Simplified Nutritional Appetite Questionnaire (SNAQ) : is a simple questionnaire for rapid assessment in patients admitted to hospital (weight loss of 3 kg per month, decreased appetite and consumption of a nutritional supplement) or receiving enteral nutrition. It includes 4 questions that can be asked by an investigator or done by the patient; the total score is between 4 and 20. A score below 14 was associated with a significant risk of: weight loss >5% within 6 months with a sensitivity of 81.5% and a specificity of 76.4%; weight loss >10% within 6 months, with a sensitivity of 88.2% and a specificity of 83.5%. Its sensitivity, specificity and reproducibility are excellent but remain inferior to those of the MNA [43].

Subjective Global Assessment (SGA): is a simple and recognized tool for assessing the risk of undernutrition and identifying the elements that could provide nutritional support for the patient. It is widely used in several fields such as oncology, transplant patients, dialysis patients, and in digestive surgery. The SGA is a reliable test, it does not require the inclusion of biological parameters. This test is divided into two sections. The purpose is to make a subjective estimate of the patient's nutritional status. The first section is called the "medical history" which consists of indicating any weight variation, whether there have been recent changes in diet or not, whether there are gastrointestinal symptoms (nausea, vomiting, diarrhea, anorexia), functional discomfort (change in performing daily activities). The second is called "physical examination" and consists of analyzing the following points: loss of subcutaneous fatty tissue, muscle atrophy, edema, ascites. A grade of A (good nutrition), B (mild undernutrition), C (severe undernutrition) is then assigned using the SGA assessment grid according to the answers to the proposals [44].

Strategies for the undernutrition management in the elderly

Once undernutrition has been diagnosed in the elderly, it is necessary to follow a strategy of gradual renutrition according to the degree of its severity. There are several possible modalities of nutritional management depending on the nutritional status, the level of protein-energy food intake and the severity of the associated pathologies:

Oral nutritional interventions

These are indicated in the first instance in cases of moderate undernutrition due to intake lack, except in cases of contra-indications [7]. It consists of restoring a balanced and varied diet, adapted to the nutritional needs and tastes of the patient; served in a pleasant, friendly and warm environment, it encourages food intake. It includes nutritional advices, assistance in food intake, food enrichment and the use of oral nutritional supplements (ONS).

In the case of undernutrition, food enrichment is indicated when food consumption does not adequately cover nutritional needs and allows for an increase in food consumption by increasing the energy and/ or protein content of a ration without increasing its volume. It consists in enriching the traditional diet with different basic products (whole milk powder, whole condensed milk, grated cheese, eggs, fresh cream, melted butter, oil or industrial protein powders, protein-enriched pasta or semolina, etc.). The evolution of weight and appetite are two markers of the effectiveness of these enrichments. Care should be taken, however, as these enrichments can unbalance the diet towards fat and sugar [45].

If fortification on the plate is not sufficient, ONS may be advised; these are indicated in patients at risk of undernutrition (oral intakes < 2/3 of requirements) or in moderately undernourished patients with spontaneous oral intakes not too low (≥2/3 of requirements) [46]. These are dietary foods (complete nutrient mixtures) administered orally, hypercaloric and/or hyperprotein, with or without fiber for undernourished patients for whom daily intakes are inadequa-te or requirements are increased. ONS are most often hyperenergetic (1.25 and 1.5 kcal/mL for the most frequently used), normo- or hyperprotein (0.035 to 0.1g/mL), and provide macronutrients, vitamins, trace elements, iron, and calcium in a small volume. They are generally very well tolerated from a digestive point of view, as they are lactose and gluten free and are available in different textures (milk drinks, creams, juices, soups...). They should be used at mealtimes to supplement inadequate oral nutrition without interfering with the usual meal, which should be preferred [47]. The efficacy of ONSs should be assessed weekly on clinical (weight monitoring, psychic and functional capacity) and/or biological (transthyretinemia) criteria. Spontaneous oral intake should also be re-evaluated because ONS should not be used as a substitute for spontaneous oral feeding [45].

Enteral nutrition

This consists of administering nutrients (proteins, lipids, carbohydrates, water, minerals and vitamins) through a nasogastric or nasojejunal tube, directly into the digestive tract, either by gastrostomy or by jejunostomy; the choice of one technique rather than another will depend on the patient's pathology, the tolerance of enteral nutrition and his habits [48].In moderately malnourished patients with insufficient oral intake, enteral nutrition should be discussed from the outset in the absence of digestive pathologies [46]. In the event of failure of oral management in a patient on an ONS, defined by weight loss and intakes below two thirds of requirements, enteral nutritional support is also indicated [46]. Enteral nutrition is initiated in the hospital (insertion of the tube, evaluation of tolerance, education of the patient and/or his family) and can then be continued at home. The administration of enteral nutrition is done either sequentially (in 3 meals) or continuously or discontinuously over 24 hours, which is cyclic during the day or night for the comfort of the patient, with the objective of progressively reaching energy intakes of 25 to 30 kcal/kg/day for 4 to 7 days, while ensuring sufficient water intake (1000 to 1500 mL/day) [7]. The digestive tracts used for enteral nutrition are [7, 49]:

Nasogastric tube: **i**s a probe that goes through the nose and allows the administration of food directly into the stomach. It is used in first intention for short nutritions of less than 3 months. It is made with a small caliber probe, flexible and comfortable in polyurethane or silicone, to be adapted according to the passage of any medication. The tube is equipped with graduation marks and must be radio-opaque in order to check the correct positioning by radiography before starting enteral nutrition. Maintaining its permeability is imperative and requires rinsing with water after each use.

G***astrostomy tube:*** is a probe that goes through the nose and allows the administration of food directly into the stomach. It is used in first intention for short nutritions of less than 3 months. It is made with a small caliber probe, flexible and comfortable in polyurethane or silicone, to be adapted according to the passage of any medication. The tube is equipped with graduation marks and must be radio-opaque in order to check the correct positioning by radiography before starting enteral nutrition. Maintaining its permeability is imperative and requires rinsing with water after each use.

Jejunostomy tube: is also performed surgically when the stomach is not functional. The food arrives directly at the level of the jejunum. The probe is made of silicone, without balloon and of large size. The mode of administration is continuous with a flow rate of less than 60 to 80 mL/h. In this case, there is less autonomy and its cleaning is identical to that of the gastrostomy.

Parenteral nutrition

This is another technique of artificial nutrition during which nutrients are supplied by the peripheral or central intravenous route via a catheter which is usually jugular or subclavian or via a subcutaneous implantable chamber [50]. Parenteral nutrition may be exclusive, where the patient's nutritional needs are met solely by this route, or it may supplement oral or enteral nutrition by providing temporary nutritional assistance [50]. It is indicated in undernourished patients when oral or enteral feeding is not possible, insufficient or not indicated [51]. In the case of nutritional assistance with moderate energy requirements (<1400Kcal/day for reasonable volumes less than 2000 mL) of short duration (≤10 days), parenteral nutrition by the peripheral venous route (PVR) is indicated; whereas the central venous route (CVR) will be preferred to achieve nutritional assistance with high energy requirements or a duration of more than ten days [46]. Nutrients used for parenteral nutrition are contained in sterile bags of 600 mL to 2600 mL and 1000 Kcal to 1800 Kcal. These bags can be bicompartmental (containing glucose and amino acid solutions) or tricompartmental (containing glucose, amino acid solutions and lipid emulsions). This limits the number of manipulations and therefore the risk of contamination of the nutrient mixture for better patient safety. These bags do not contain trace elements and vitamins, so they must be added systematically [52].
It is recommended to initiate parenteral nutrition at 20 to 25 Kcal/kg/day, then after 48 hours, to increase caloric intake progressively to reach the patient nutritional requirements: 25 to 30 Kcal/kg/day and 1.2 to 1.5 g of protein/kg/day and 30 to 40 mL of water intake/kg/day. It is also recommended that parenteral nutrition be administered cyclically, preferably at night, and by infusion pump [52,53]. Rigorous hygiene is essential when inserting a parenteral nutrition bag in order to avoid infectious complications [54].

Conclusion

Undernutrition is a frequent co-morbidity in the elderly, it presents an important morbi-mortality factor in this population which implies an early diagnosis and management in order to prevent complications, to limit the dependence of elderly subjects and to reduce the costs related to this pathology. The diagnosis of undernutrition is most often based on a set of simple and accessible clinical, biological and paraclinical elements that allow the easy identification of the nutritional disorder in the elderly. The introduction of new instrumental techniques for assessing nutritional status in the elderly, such as bioelectrical impedancemetry and dual energy X-ray absorptiometry, allows for punctual detection of undernutrition and determination of the undernourished subject body composition and its evolution. One of the solutions to undernutrition in the elderly is oral nutritional supplementation, mainly in the early stages of undernutrition and in subjects at undernutrition risk. The enteral and parenteral artificial nutrition techniques are indicated in the advanced stages and allow to ensure a better nutritional status and to reduce the risk of complications.

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Conflict of Interests

The authors declare no conflict of interests.

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