



## ESPEN Guidelines on Parenteral Nutrition: Geriatrics

L. Sobotka<sup>a</sup>, S.M. Schneider<sup>b</sup>, Y.N. Berner<sup>c</sup>, T. Cederholm<sup>d</sup>, Z. Krznaric<sup>e</sup>, A. Shenkin<sup>f</sup>, Z. Stanga<sup>g</sup>, G. Toigo<sup>h</sup>, M. Vandewoude<sup>i</sup>, D. Volkert<sup>j</sup>

<sup>a</sup> Department of Metabolic Care and Gerontology, Medical Faculty, Charles University, Hradec Králové, Czech Republic

<sup>b</sup> Nutritional Support and Intestinal Transplant Unit, Archet University Hospital, University of Nice Sophia-Antipolis, Nice, France

<sup>c</sup> Meir Medical Centre, Tel Aviv University, Sackler Medical School, Tel Aviv, Israel

<sup>d</sup> Department of Public Health and Caring Sciences/Clinical Nutrition and Metabolism, Uppsala University, Uppsala Science Park, Uppsala, Sweden

<sup>e</sup> Department of Gastroenterology & Clinical Nutrition, Clinical Hospital Center and School of Medicine Zagreb, Zagreb, Croatia

<sup>f</sup> Department of Clinical Chemistry, University of Liverpool, Liverpool, UK

<sup>g</sup> Division of Endocrinology, Diabetes and Clinical Nutrition, Department of General Internal Medicine, University Hospital, Bern, Switzerland

<sup>h</sup> Geriatric Unit, Division of Internal Medicine, Department of Clinical Morphological Technological Sciences, University of Trieste, Trieste, Italy

<sup>i</sup> Department of Geriatrics, University of Antwerp, Ziekenhuisnetwerk Antwerpen (ZNA), Antwerp, Belgium

<sup>j</sup> Departments of Nutrition and Food Science, University of Bonn and Pfrimmer Nutricia, Erlangen, Germany

### ARTICLE INFO

#### Article history:

Received 4 February 2009

Accepted 1 April 2009

#### Keywords:

Nutritional support in the elderly  
Enteral nutrition in the elderly  
Parenteral nutrition in the elderly  
Malnutrition in the elderly  
Subcutaneous fluid administration

### SUMMARY

Older subjects are at increased risk of partial or complete loss of independence due to acute and/or chronic disease and often of concomitant protein caloric malnutrition. Nutritional care and support should be an indispensable part of their management. Enteral nutrition is always the first choice for nutrition support. However, when patients cannot meet their nutritional requirements adequately via the enteral route, parenteral nutrition (PN) is indicated.

PN is a safe and effective therapeutic procedure and age *per se* is not a reason to exclude patients from this treatment. The use of PN should always be balanced against a realistic chance of improvement in the general condition of the patient. Lower glucose tolerance, electrolyte and micronutrient deficiencies and lower fluid tolerance should be assumed in older patients treated by PN. Parenteral nutrition can be administered either via peripheral or central veins. Subcutaneous administration is also a possible solution for basic hydration of moderately dehydrated subjects. In the terminal, demented or dying patient the use of PN or hydration should only be given in accordance with other palliative treatments.

© 2009 European Society for Clinical Nutrition and Metabolism. All rights reserved.

### Preliminary remarks

An elderly subject is usually defined, in western countries, as a person over the age of 65 (WHO). A geriatric patient is an older adult seeking medical care. He or she may be independent and generally healthy needing mainly preventive care, but is often someone who has a loss of independence caused by acute and/or chronic diseases (often multiple pathology) with related limitations in physical, psychological, mental, cognitive and/or social functions. The ability to perform the basic activities of independent daily living may then be jeopardised or lost. Such a person is in increased need of rehabilitative, physical, psychological and social care to avoid partial or complete loss of independence. Moreover muscle mass deficit, i.e. sarcopenia, is a frequent comorbid situation.

Studies have shown an inverse relationship between nutritional status and complication rates (e.g. mortality, infections, and

pressure ulcers), length of stay in hospital and duration of convalescence after acute illness in geriatric patients.

A reduced capacity for rehabilitation is characteristic of older patients, making it more difficult to rehabilitate and to return the patient to normal or to his/her previous condition. Muscle mass restoration is more complicated in terms of exercise and nutrition than in younger patients.<sup>1</sup>

Many factors that compromise nutrient and fluid intake increase the risk of undernutrition with a progressive loss of lean body mass. Since restoration of body cell mass is more difficult in older persons,<sup>1</sup> preventative nutritional support with adequate intake of energy, protein and micronutrients should be considered in every elderly patient.

Nutritional care should be an integral part of the overall care plan, which takes into account all aspects of the patient. A comprehensive assessment should include nutritional status and risk. A nutritional programme taking into account ethical as well as clinical considerations should be implemented.<sup>2</sup> Appropriately minimising the need for parenteral nutrition, less physiological and

E-mail address: [espenjournals@espen.org](mailto:espenjournals@espen.org).

## Summary of statements: Geriatrics

| Subject   | Recommendations  | Grade   | Number |
|---|--|---------|--------|
| <b>Indications</b>  | Age per se is not a reason to exclude patients from PN.  | C [IV]  | 1.1.   |
|   | PN is indicated and may allow adequate nutrition in patients who cannot meet their nutritional requirements via the enteral route.   | C [IV]  | 1.1.   |
|   | PN support should be instituted in the older person facing a period of starvation of more than 3 days or if intake is likely to be insufficient for more than 7–10 days, and when oral or enteral nutrition is impossible. | C [IV]  | 1.1.   |
|   | Pharmacological sedation or physical restraining to make PN possible is not justified.   | C [IV]  | 1.1.   |
|   | PN is a useful and effective method of nutritional support in older persons but compared to EN and oral nutritional supplements are much less often justified.   | B [III] | 1.2.   |
| <b>Metabolic/physiological features in older subjects</b> | Insulin resistance and hyperglycaemia together with impairment of cardiac and renal function are the most relevant features. They may warrant the use of formulae with higher lipid content.                               | C [IV]  | 2      |
|   | Deficiencies in vitamins, trace elements and minerals should be suspected in older subjects.   | B [IIb] | 2      |
|   | The effect of nutritional support on restoration of depleted body cell mass is lower in elderly patients than in younger subjects. The oxidation capacity for lipid emulsions is not negatively influenced by age.         | B [IIa] | 2      |
| <b>Peripheral PN</b>                                      | Both central and peripheral nutrition can be used in geriatric patients.   | C [IV]  | 3      |
|   | Osmolarity of peripheral parenteral nutrition should not be higher than 850 mOsmol/l.  | B [III] | 3      |
| <b>Subcutaneous fluid administration</b>                  | The subcutaneous route is possible for fluid administration in order to correct mild to moderate dehydration but not to meet other nutrient requirements.  | A [Ia]  | 4      |
| <b>PN and nutritional status</b>                          | PN can improve nutritional status in older as well as in younger adults. However, active physical rehabilitation is essential for muscle gain.   | B [IIb] | 5      |
| <b>Functional status</b>                                  | PN can support improvement of functional status, but the margin of improvement is lower than in younger patients.  | C [IV]  | 6      |
| <b>Morbidity and mortality</b>                            | PN can reduce mortality and morbidity in older as well as in middle-aged subjects.   | C [IV]  | 7      |
| <b>Length of hospital stay</b>                            | No studies have assessed length of hospital stay in older patients on PN.  |         | 8      |
| <b>Quality of life</b>                                    | Long-term parenteral nutrition does not influence quality of life of older patients more negatively than it does in younger subjects.  | C [IV]  | 9      |
| <b>Specific complications</b>                             | There are no specific complications of PN in geriatric patients compared to other ages, but complications tend to be more frequent due to associated comorbidities.  | C [IV]  | 10     |
| <b>Specific situations</b>                                | Indications for PN are similar in younger and older adults in the hospital and at home.  | B [III] | 11     |
| <b>Ethical problems</b>                                   | PN or parenteral hydration should be considered as medical treatments rather than as basic care. Therefore their use should be balanced against a realistic chance of improvement in the general condition.                | C [IV]  | 12     |

more invasive than the enteral route, demands that frailty be detected and characterised in a timely and precise manner. This assessment is thus a crucial step in the diagnostic work-up of these patients<sup>3</sup> and the methodological approach should be multidimensional such as those proposed by national societies of geriatrics; even in this context it is important that the action of the clinical nutritionist is integrated with that of the geriatrician and other medical specialists (in particular, the neurologist, psychiatrist, and rehabilitation specialist).

In designing the programme, it should be remembered that the majority of sick elderly patients require at least 1.0–1.2 g protein/kg per day and 20–30 kcal/kg per day of non-protein energy,<sup>4,5</sup> depending on the severity of the disease, the degree of current inflammation/catabolism, the physical activity level and the need and time course of rehabilitation. Although, current literature review suggests that slightly higher protein amounts (1.5 g/kg per day) should be warranted in the malnourished elderly to improve nitrogen balance and restore lean body mass,<sup>4</sup> studies specifically addressing protein supply by parenteral route are still lacking. Nevertheless, in acutely hospitalised older patients energy intake is rarely sufficient to cover the basal energy expenditure (BEE).<sup>5</sup> Many older people also suffer from specific micronutrient deficiencies, which should be corrected by supplementation.

Institution of PN in older subjects generates the same medical and ethical problems as EN and therefore the same questions should be asked<sup>6</sup>:

- Does the patient suffer from a condition that is likely to benefit from PN?
- Will PN improve outcome and/or accelerate recovery?
- Does the patient suffer from an incurable disease, but nevertheless quality of life and wellbeing can be maintained or improved by PN?
- Does the anticipated benefit outweigh the potential risks?

- Does PN accord with the expressed or presumed will of the patient, or in the case of incompetent patients, of his/her legal representative?
- Are there sufficient resources available to manage PN properly?
- If long-term PN implies a different living situation (e.g. institution vs. home), will the patient derive benefit from it?

## 1. Indications for PN in older persons

### 1.1. Is PN indicated in geriatric patients?

**PN is a safe and effective therapeutic procedure, on the condition that it is provided by an experienced team. Age per se is not a reason to exclude patients from PN (C).**

**PN is indicated and may allow adequate nutrition in patients who cannot meet their nutritional requirements via the enteral route, and should be limited to situations when EN is contraindicated or poorly tolerated (C).**

**PN support should be instituted in the older person facing a period of starvation of more than 3 days when oral or enteral nutrition is impossible, and when oral or enteral nutrition has been or is likely to be insufficient for more than 7–10 days (C).**

**Pharmacological sedation or physical restraining of the patient to make PN possible is not justified (C).**

**Comments:** Malnutrition is widespread in older people and is reported in more than half of geriatric patients at the time of hospital admission (III).<sup>7</sup> In nursing homes and long-term care institutions even more subjects may be affected. However reported prevalence rates vary according to the methods used for nutritional assessment and the specific characteristics of the population under study (III).<sup>8</sup> Nutritional care should be an integral part of the overall care plan. Nutritional support is indicated when patients are at

risk of developing malnutrition-related complications or when adequate nutrition is impossible and should be started in a timely fashion.<sup>6</sup>

Enteral nutrition (EN, including oral and enteral routes) should always be the first choice.<sup>6</sup> In patients who cannot meet their nutritional requirements via the enteral route, parenteral nutrition (PN) may allow adequate nutrition. PN is a safe and effective method of nutrition support for most patients – including older patients. However, it remains an invasive and costly method potentially causing numerous complications, and potentially requiring intensive nursing care. Therefore it should be restricted to patients who cannot receive adequate nutrition by the enteral route.

This may be the case in patients who are unable to receive EN (gut failure, high-output fistulas, uncontrollable diarrhoea) or in whom EN alone cannot meet the energy and nutritional requirements, e.g. when tube feeding is poorly tolerated. Many geriatric patients have cognitive deficits or other mental impairments that may enhance the risk of temporary confusional states during somatic illnesses. Under such conditions naso-gastric tubes are likely to be removed by the patient. Along with this, age-associated changes in the physiology of the gastrointestinal tract should be considered in regard to the effectiveness of nutrient absorption, particularly during critical illness.<sup>9</sup> Thus, oral/enteral and parenteral nutrition are not mutually exclusive but may complement one another.

Subjects, who receive geriatric care at home, including PN, need considerable support from family members. The appropriateness of this kind of specialised nutritional support should be considered with caution, taking into account the patient's particular circumstances such as probable survival, rehabilitation potential and complication risk.

## 1.2. Is PN a useful method in older malnourished patients?

**PN is a useful method of nutritional support in older malnourished patients; however, compared to EN and oral nutritional supplements PN is much less often justified in geriatric patients (B).**

**Comments:** Several studies have documented that PN is a feasible and successful method of nutritional support in older people. In a British survey on PN in 15 hospitals in Northern England, the median age of PN patients was 67 years (range 20–90). Thus, more than one half of adult patients on PN are older than 65 (III).<sup>10</sup>

Similarly, the mean age of 159 parenterally nourished outpatients from the Clinical Nutrition Unit for Home PN of the Federico II University Hospital in Naples, Italy (referred from oncology, neurology or surgery units) was  $60.1 \pm 14.2$  years with a median value of 63 and a maximum of 93 years (III).<sup>11</sup> Along with this, a further recent Italian survey, investigating the negative outcome of artificial nutrition (cases: EN, 57%; total PN, 30%; “mixed”, 13%), demonstrated that death or interruption (due to worsening clinical conditions within the initial 10 days of treatment) were meaningfully higher in those aged >80 years and unrelated to the route of administration when corrected for the indications.<sup>12</sup>

Reported prevalence rates of PN are, however, very low. In a prospective study of adjunctive peripheral PN in subacute care patients, Thomas et al. screened 1140 consecutive admissions for patients receiving inadequate EN. By using stringent criteria (e.g. signs of malnutrition, low intake, no EN, no end stage disease) they identified only 19 patients (1.7%; mean age 83 years) who were considered eligible for peripheral PN and finally consented to this (III).<sup>13</sup> The low prevalence of PN may be explained by the fact that oral and enteral interventions are generally the first choice for

nutritional support. Only a few malnourished older subjects cannot be enterally fed. Another reason might be that, at present, malnutrition is often overlooked and left untreated. In addition PN might be underutilised because it is often not considered as a possible and practical way of nutrient delivery. However, a recent quality control study in the Geneva University Hospital highlighted that, even when highly justified, PN is frequently inadequate in terms of energy, protein, vitamins or trace elements administration and further optimisation of current practice is needed.<sup>14</sup>

As a consequence of demographic changes with an increase in life expectancy the number of older people requiring (home) PN will rise in the future. This is particularly true for the oldest old patients (>90 years old), a group in whom artificial nutrition is poorly studied. For these patients there is no exhaustive literature on any form of artificial nutrition, even though clinical experience suggests that adequate and timely nutritional treatment is fundamental.

## 2. Are there any metabolic/physiological features in older subjects that may affect their response to PN?

**Insulin resistance, leading to a lower glucose utilisation and hyperglycaemia together with impairment of cardiac and renal function are the most relevant features. They may warrant the use of formulae with higher lipid content – up to 50% of total energy intake (C).**

**Deficiencies in vitamins, trace elements and minerals should be suspected in older subjects (B). The effect of nutritional support on restoration of depleted body cell mass is lower in elderly patients than in younger subjects; however, the oxidation capacity for lipid emulsions is not negatively influenced by age (B).**

**Comments:** Insulin resistance and the prevalence of diabetes mellitus increase with age. Therefore impaired glucose tolerance should be looked for in the elderly.<sup>15</sup>

Vitamin and mineral deficiencies are more prevalent than in younger subjects. Many older patients will already have impaired status of trace elements and vitamins at the time they commence nutritional support. There is good evidence from the United Kingdom and from the United States that up to 40% of individuals aged 65 or more have an inadequate intake of one or more vitamins or minerals (ascorbate, folate, B12, thiamine, riboflavin, magnesium, iron and zinc) with associated low blood concentrations<sup>16,17</sup> (IIb). Such abnormalities occur in free living as well as institutionalised individuals, especially in those regarded as “food insecure”. Abnormalities are also common in patients admitted to hospital, probably as a result of recently reduced intake despite the increased demands of illness, as well as a poor underlying nutritional state.<sup>18</sup> All essential vitamins and trace elements should therefore be given from the beginning of the course of PN;<sup>19</sup> this can be considered an effective way to achieve micronutrient repletion and correction. In addition, mild ( $<0.77 \text{ mmol l}^{-1}$ ) to severe ( $<0.45 \text{ mmol l}^{-1}$ ) hypophosphataemia is frequently found on admission, and particularly commonly develops, in older malnourished patients (~5 and 14.1% respectively according to Kagansky et al.<sup>20</sup>).

Cardiac and renal functions are more likely to be impaired in older persons. Therefore fluid and sodium intake should be limited, and especially so during periods of mobilisation of extracellular water that has accumulated due to inflammatory processes or during an earlier stage of refeeding (III).<sup>21–23</sup>

A study in 325 patients on PN has shown that with a similar nutritional intake, depleted body cell mass was restored more slowly in older patients. Age was a significant independent variable

affecting the response to nutritional support (IIb).<sup>1</sup> Probably, given the effect of both aging and related insulin resistance on body cell mass turnover,<sup>4</sup> more protein calories should be delivered but this hypothesis still need to be explored.

A study in twenty healthy volunteers submitted to a hypertriglyceridaemic clamp showed a similar capacity in young and older subjects to oxidise a high intravenous triglyceride load (IIa).<sup>24</sup> However, another study in 24 patients with intestinal failure showed a markedly higher lipid oxidation along with a lower glucose oxidation, which may contribute to the frequent hyperglycaemia seen in older PN patients (IIa).<sup>25</sup>

### 3. Is peripheral PN feasible in geriatric patients?

**Both central and peripheral nutrition can be used in geriatric patients (C).**

**Osmolarity of peripheral parenteral nutrition should not be higher than 850 mOsmol/l (B).**

**Comments:** Administration of parenteral nutrition via peripheral veins is a method which can be used safely in an older patient. Moreover, this approach allows early infusion of nutritional substrates during acute illness without the need to insert a central venous catheter. There are no consistent studies, which compare different osmolarities during peripheral PN in geriatric patients. However in adult subjects it was found that using very fine bore silicon or polyurethane catheters and infusion pump-controlled continuous administration, the osmolality of intravenous peripheral nutrition can be tolerated up to 1000 mOsmol/l. This allows the administration of a sufficient amount of macro- and micronutrients via peripheral veins over periods of 2–3 weeks. Peripheral PN can cover nutrition needs in older patients who may receive regimens incorporating up to 1700 kcal, 60 g of amino acids, 60–80 g of lipids and 150–180 g of carbohydrates per day in a typical volume of 2400 ml. This is deemed possible in 50% of patients (Ib).<sup>26</sup> However, other published guidelines for peripheral PN suggest that osmolarity of nutritional solutions should be limited to no more than 900 mOsmol/l.<sup>27</sup>

In the UK, utilisation of peripheral PN rose from 9% of adult patients on PN in 1988 to 18.3% in 1994. This was due to improved peripheral catheters (fine bore silicone or polyurethane catheters) and better delivery systems (all in one bags, infusion pumps).<sup>28</sup> The recent availability of peripherally inserted catheters for both peripheral (midline catheters) and central (PICC) PN might help in controlling the incidence of infectious or thrombotic complications in parenteral nutrition.<sup>29,30</sup> It was demonstrated that up to 70% of the patients were suitable for peripheral PN, and that 50% completed a full course. However, the peripheral route should be limited to those with an anticipated duration of feeding of no more than 10–14 days.<sup>31,32</sup>

### 4. Is there a role for subcutaneous fluid administration in geriatric patients?

**Peripheral or central venous access for fluid and electrolyte replacement is mandatory in emergencies and in situations where strict fluid balance is required. The subcutaneous route is possible for fluid administration in order to correct mild to moderate dehydration but not to meet other nutrient requirements (A).**

**Comments:** Hypodermoclysis (HDC), the method of correcting fluid deficits by subcutaneous infusion may be an alternative to intravenous cannulation in older patients (IIa). Isotonic fluids are introduced into subcutaneous tissues seeking the correction of

mild to moderate dehydration, especially in chronic care settings where the intravenous route is particularly difficult.<sup>33,34</sup> In addition, this technique is less invasive for drug administration in palliative management where opioid and antiemetic therapy is frequently necessary.<sup>35,36</sup> Fluid replacement by hypodermoclysis is relatively safe and easy to initiate, demands less nursing time, is more cost effective than intravenous treatment, causes less discomfort, minimises the risk of intravascular infection, does not immobilise a limb, and has been found to be less distressing for the patients. The technique can be used in the nursing home and home setting and, thus, can prevent the stress of hospitalisation.<sup>37–40</sup> The use of hyaluronidase in the infused solution augments the rate of fluid uptake, and volumes up to 3000 ml have been delivered over 24 h.<sup>41</sup>

Hypodermoclysis is, however, not appropriate when large fluid volumes are needed in short time periods or for infusing electrolyte-free or hypertonic solutions in emergency situations. Most units limit daily volumes to no more than 1 l.

The principal procedural disadvantages of subcutaneous fluid treatment are local oedema and infection at the infusion site, but the reported incidence of the latter is extremely low.<sup>42</sup>

In a recent systematic review Remington & Hultman found two RCTs and six cohort studies on the use of HDC to treat dehydration in older adults.<sup>34</sup> They concluded that HDC is as effective as IV rehydration of older adults with mild to moderate dehydration. Several advantages of HDC over IV hydration are described: lower complication rate, lower costs, greater patient comfort, less nursing time to start and maintain the infusion.<sup>35</sup> However, it should be kept in mind that HDC is only a method for hydration and does not meet other nutrient requirements.

### 5. Can PN maintain or improve nutritional status

**PN can improve nutritional status in older as well as in younger adults. However, active physical rehabilitation is essential for muscle gain (B).**

**Comments:** There is no high quality trial which compares the effect of PN with EN in a group of older patients. It is apparent from experimental stable isotope studies that intravenous nutrition (especially amino acid administration) could increase fraction synthesis rate in old as well as in younger malnourished patients<sup>43</sup> (IIb), particularly in hypercatabolic cancer patients when tight glucose control is achieved.<sup>44</sup> It should be stressed that physical activity is a necessary condition for significant muscle gain in both groups<sup>45</sup> (IIb).

### 6. Can PN maintain or improve functional status?

**PN can support improvement of functional status, but the margin of improvement is lower than in younger patients (C).**

**Comments:** Howard and Malone found that 38% of older (>65 years) patients receiving home PN reached full rehabilitation capacity in comparison with 62% in middle-aged (35–55 years) and 63% in paediatric (0–18 years) subjects (III).<sup>46</sup>

### 7. Can PN reduce morbidity and mortality?

**PN can reduce mortality and morbidity in older as well as in middle-aged subjects. However, as PN has more complications than EN, the oral and enteral route should be used whenever possible (C).**

**Comments:** Mortality is higher in older patients on PN than in younger ones. In Howard and Malone's study, 1 year mortality was

29% in comparison with 8 and 6% in middle-aged and paediatric patients respectively. This is partly due to the fact that older patients are more frequently on PN for diagnoses which themselves carry a poor prognosis such as ischaemic bowel disease, radiation enteritis and cancer (III).<sup>46</sup>

### 8. Can PN reduce length of hospital stay?

**No studies have assessed length of hospital stay in older patients on PN.**

**Length of hospital stay (LOS) is a secondary endpoint commonly used in clinical research. In malnourished patients, particularly those aged >65 years, it is significantly longer and associated with a doubling of costs. This is so in relation to delayed physical recovery, worse tolerance to and more intensive pharmacological treatments, as well as increased proneness to complications.<sup>47</sup> Up to now, there are very scant data about LOS in older patients on PN.**

### 9. Can PN improve quality of life?

**There are no specific data on the effect of PN on quality of life in older people. However, parenteral nutrition does not influence quality of life of older patients more negatively than it does in younger subjects (C).**

**Comments:** Primary or ongoing disease influences quality of life more than PN. An Israeli study of 51 long-term HPN patients (eight of whom were aged 60 years or more) found impaired quality of life, physical activity and oral intake, all of which were uninfluenced by age (III).<sup>48</sup> However, as PN can sustain life, a minimum quality of life should be anticipated before initiating PN.

### 10. Are there specific complications of PN in older people?

**There are no specific complications of PN in geriatric patients compared to other ages. However, complications tend to be more frequent due to associated comorbidities (C).**

**Comments:** In general, older patients show the same complications as younger adults with comparable rates<sup>46</sup> (IIb). Confusion during somatic illness is more generally more common in geriatric patients and the syndrome of geriatric delirium may occur. During periods of confusion the tolerability of the intravenous catheter is reduced. The most appropriate insertion location of the catheter requires consideration, and the catheter may need to be protected by bandaging.

Due to the risk of cardiac failure, water and sodium intake is often limited. With more vulnerable water homeostasis, and a tendency to an increase in extracellular and a decrease in intracellular water both hypo- and hypervolaemia are prone to occur.<sup>49</sup> This is further complicated by a higher use of diuretic drugs in this population. These factors may also contribute to the thrombosis which is thought more common in the elderly on PN.

Risk factors for bloodstream infections were estimated to be present in 39% (III) of 200 PN patients,<sup>50</sup> or in 6% of 281 patients.<sup>51</sup> These analyses did not include age. Such data confirm the findings of the ESPEN HAN group in 447 HPN patients (representing over 100,000 catheter days)<sup>52</sup> (III). However older age was associated with a higher risk of central catheter vascular erosion in a prospective study of 1499 patients (2992 catheters)<sup>53</sup> (III).

Hypophosphataemia plays a major role in the development of the refeeding syndrome. As phosphate is mainly intracellular, great losses occur in parallel with loss of muscle mass and progressive osteoporosis, both of which are more common in the elderly. Low

intake during undernutrition aggravates prior latent deficiencies. PN (especially glucose) infusion can provoke a rapid drop in plasma phosphate level leading to acute psychotic changes and delirium.<sup>20,54</sup> Moreover glucose infusion, through the sudden increase in insulin can cause acute water and/or sodium retention.<sup>55</sup> Very low plasma levels of potassium or magnesium have also been reported, as a result of intracellular ion shift. Therefore in severely malnourished older subjects a stepwise increase of substrate intake (especially glucose) is necessary with strict monitoring of plasma electrolyte levels and timely ad-hoc corrections.<sup>23,55</sup> Thiamine deficiency can also be evoked in the refeeding syndrome causing Wernicke's or Korsakov's syndromes, with related features such as diplopia, confabulation, confusion and coma.

### 11. Is PN indicated in specific situations in older people?

**Indications for PN are similar in younger and older adults in the hospital and at home. These indications are limited to situations when EN is contraindicated or poorly tolerated (B).**

**Comments:** In Europe in 1997, patients over the age of 61 represented 28% of all HPN patients,<sup>56</sup> a percentage comparable to that observed in the US.<sup>46</sup> Survival and rehabilitation are lower among older HPN patients compared to middle-aged and young patients.<sup>46</sup> A UK survey of 188 patients (963 patient-years of HPN) included over a 25 year period found a lower survival probability among older when compared to younger patients. However, HPN dependence among survivors was not affected by age (III).<sup>57</sup>

### 12. Are there ethical problems of artificial nutrition and fluid management in terminal, demented or dying older persons?

**PN and parenteral hydration should be considered as medical treatments rather than as basic care. Both require intravenous cannulation and a physician's prescription. Their use should therefore be balanced against a realistic chance of improvement in the general condition (C).**

**Comments:** In patients where death is imminent, e.g. within the next 4 weeks, or in patients with advanced Alzheimer's disease or vascular dementia, the use of PN or hydration should be the result of careful and interdisciplinary reflection. Comfort is the highest priority, and nutritional support should be in accord with other palliative treatments.

The decision to start artificial nutrition in people with dementia is controversial. Studies on the effect of PN in this patient group are limited. In a Dutch study which investigated the practice in nursing homes only 3.4% of the demented residents received artificial nutrition or hydration during a 1 year observation period. The most important considerations in the decision to start artificial nutrition or hydration were the patient's clinical condition and the anticipated result of rehydration.<sup>58</sup>

Patients with mild to moderate dementia and lower respiratory tract infection received significantly more nutritional therapy and hydration in nursing homes in Missouri than in The Netherlands.<sup>59</sup> Identifying cultural differences in treatment approach may therefore challenge researchers to evaluate existing assumptions, leading to practices that are more evidence based. Whether physicians internationally will ultimately agree on uniform treatment guidelines, the discussion of differences will serve to clarify key issue.<sup>50</sup> Cultural background, economical resources, social facilities as well as ethical and religious motivations may play a substantial role in determining the nutritional treatment and its outcome in dementia as well as in very old, frail and chronically ill patients.<sup>12</sup>

## Conflict of interest

Conflict of interest on file at ESPEN ([espenjournals@espen.org](mailto:espenjournals@espen.org)).

## References

- Shizgal HM, Martin MF, Gimmon Z. The effect of age on the caloric requirement of malnourished individuals. *Am J Clin Nutr* 1992;**55**:783–9.
- Arora VM, Johnson M, Olson J, Podrznick PM, Levine S, Dubeau CE, et al. Using assessing care of vulnerable elders quality indicators to measure quality of hospital care for vulnerable elders. *J Am Geriatr Soc* 2007;**55**:1705–11.
- Hogan DB, MacKnight C, Bergman H. The Canadian initiative on frailty and aging. *Aging Clin Exp Res* 2003;**15**(3S):1–29.
- Wolfe RR, Miller SL, Miller KB. Optimal protein intake in the elderly. *Clin Nutr* 2008;**27**:675–84.
- Alix E, Berrut G, Boré M, Bouthier-Quintard F, Buia JM, Chlala A, et al. Energy requirements in hospitalized elderly people. *JAGS* 2007;**55**:1085–9.
- Volkert D, Berner YN, Berry E, Cederholm T, Coti Bertrand P, Milne A, et al. ESPEN Guidelines on Enteral Nutrition: Geriatrics. *Clin Nutr* 2006;**25**:330–59.
- Pirlich M, Schutz T, Norman K, Gastell S, Lubke HJ, Bischoff SC, et al. The German hospital malnutrition study. *Clin Nutr* 2006;**25**:563–72.
- Pauly L, Stehle P, Volkert D. Nutritional situation of elderly nursing home residents. *Z Gerontol Geriatr* 2007;**40**:3–12.
- Drozdzowski L, Thomson AB. Aging and the intestine. *World J Gastroenterol* 2006;**12**:7578–84.
- Hearnshaw SA, Thompson NP. Use of parenteral nutrition in hospitals in the North of England. *J Hum Nutr Diet* 2007;**20**:14–23.
- Violante G, Alfonsi L, Santarpia L, Cillis MC, Negro G, De Caprio C, et al. Adult home parenteral nutrition: a clinical evaluation after a 3-year experience in a Southern European centre. *Eur J Clin Nutr* 2006;**60**:58–61.
- Coletti C, Paolini M, Scavone L, Felice MR, Laviano A, Rossi Fanelli F, et al. Predicting the outcome of artificial nutrition by clinical and functional indices. *Nutrition* 2009;**25**:11–9.
- Thomas DR, Zdrodowski CD, Wilson MM, Conright KC, Diebold M, Morley JE. A prospective, randomized clinical study of adjunctive peripheral parenteral nutrition in adult subacute care patients. *J Nutr Health Aging* 2005;**9**:321–5.
- Nardo P, Dupertuis YM, Jetzer J, Kossovsky MP, Darmon P, Pichard C. Clinical relevance of parenteral nutrition prescription and administration in 200 hospitalized patients: a quality control study. *Clin Nutr* 2008;**27**:858–64.
- Morley JE. Nutrition in the elderly. *Curr Opin Gastroenterol* 2002;**18**:240–5.
- Finch S, Doyle W, Lowe C, Bates CJ, Prentice A, Smithers G, et al. *National diet and nutrition survey: people aged 65 years and over*. London: The Stationery Office; 1998.
- Lee JS, Frongillo EA. Nutritional and health consequences are associated with food insecurity among U.S. elderly persons. *J Nutr* 2001;**131**:1503–9.
- Jamieson CP, Obeid OA, Powell-Tuck J. The thiamine, riboflavin and pyridoxine status of patients on emergency admission to hospital. *Clin Nutr* 1999;**18**:87–91.
- National Institute for Health and Clinical Excellence. Nutrition Support in Adults; 2006 <http://www.nice.org.uk>.
- Kagansky N, Levy S, Koren-Morag N, Berger D, Knobler H. Hypophosphataemia in old patients is associated with the refeeding syndrome and reduced survival. *J Intern Med* 2005;**257**:461–8.
- Allison SP, Lobo DN. Fluid and electrolytes in the elderly. *Curr Opin Clin Nutr Metab Care* 2004;**7**:27–33.
- Kinney JM, Allison SP. Food, fluids and pharmacy in the elderly. *Curr Opin Clin Nutr Metab Care* 2004;**7**:1–2.
- Stanga Z, Brunner A, Leuenberger M, Grimble RF, Shenkin A, Allison SP, et al. Nutrition in clinical practice—the refeeding syndrome: illustrative cases and guidelines for prevention and treatment. *Eur J Clin Nutr* 2008;**62**:687–94.
- Aberg W, Thorne A, Olivecrona T, Nordenstrom J. Fat oxidation and plasma removal capacity of an intravenous fat emulsion in elderly and young men. *Nutrition* 2006;**22**:738–43.
- Al-Jaouni R, Schneider SM, Rampal P, Hebuterne X. Effect of age on substrate oxidation during total parenteral nutrition. *Nutrition* 2002;**18**:20–5.
- Anderson AD, Palmer D, MacFie J. Peripheral parenteral nutrition. *Br J Surg* 2003;**90**:1048–54.
- Mirtallo J, Canada T, Johnson D, Kumpf V, Petersen C, Sacks G, et al. Task force for the revision of safe practices for parenteral nutrition. Safe practices for parenteral nutrition. *J Parenter Enteral Nutr* 2004;**28**:S39–70.
- Payne-James JJ, De Gara CJ, Grimble GK, Bray MJ, Rana SK, Kapadia S, et al. Artificial nutrition support in hospitals in the United Kingdom – 1991: second national survey. *Clin Nutr* 1992;**11**:187–92.
- Giorgetti GM, Gravante GF, Pittiruti M. Peripherally inserted central catheters and midline catheters in artificial nutrition. Indications and limits. *Nutr Ther Metab* 2006;**24**:164–7.
- O'Grady NP, Alexander M, Dellinger EP, Gerberding JL, Heard SO, Maki DG, et al. Guidelines for prevention of intravascular catheter related infections. Centers for Disease Control and Prevention. *MMWR Recomm Rep* 2002;**51**(RR-10):1–29.
- Couse N, Pickford LR, Mitchell CJ, Macfie J. Total parenteral nutrition by peripheral vein – substitute or supplement to the central venous route? A prospective trial. *Clin Nutr* 1993;**12**:213–6.
- Everitt NJ, Wong C, McMahon MJ. Peripheral infusion as the route of choice for intravenous nutrition: a prospective two year study. *Clin Nutr* 1996;**15**:69–74.
- Dasgupta M, Binns MA, Rochon PA. Subcutaneous fluid infusion in a long-term care setting. *J Am Geriatr Soc* 2000;**48**:795–9.
- Remington R, Hultman T. Hypodermoclysis to treat dehydration: a review of the evidence. *J Am Geriatr Soc* 2007;**55**:2051–5.
- Bruera E, Legris MA, Kuehn N, Miller MJ. Hypodermoclysis for the administration of fluids and narcotic analgesics in patients with advanced cancer. *J Pain Symptom Manage* 1990;**5**:218–20.
- O'Keefe ST, Lavan JN. Subcutaneous fluids in elderly hospital patients with cognitive impairment. *Gerontology* 1996;**42**:36–9.
- Barua P, Bhowmick BK. Hypodermoclysis—a victim of historical prejudice. *Age Ageing* 2005;**34**:215–7.
- Frisoli Junior A, de Paula AP, Feldman D, Nasri F. Subcutaneous hydration by hypodermoclysis. A practical and low cost treatment for elderly patients. *Drugs Aging* 2000;**16**:313–9.
- Rochon PA, Gill SS, Litner J, Fischbach M, Goodison AJ, Gordon M. A systematic review of the evidence for hypodermoclysis to treat dehydration in older people. *J Gerontol A Biol Sci Med Sci* 1997;**52**:M169–76.
- Turner T, Cassano AM. Subcutaneous dextrose for rehydration of elderly patients—an evidence-based review. *BMC Geriatr* 2004;**4**:2.
- Berger EY. Nutrition by hypodermoclysis. *J Am Geriatr Soc* 1984;**32**:199–203.
- Jain S, Mansfield B, Wilcox MH. Subcutaneous fluid administration—better than the intravenous approach? *J Hosp Infect* 1999;**41**:269–72.
- Volpi E, Ferrando AA, Yeckel CW, Tipton KD, Wolfe RR. Exogenous amino acids stimulate net muscle protein synthesis in the elderly. *J Clin Invest* 1998;**101**:2000–7.
- Biolo G, De Cicco M, Lorenzon S, Dal Mas V, Fantin D, Paroni R, et al. Treating hyperglycemia improves skeletal muscle protein metabolism in cancer patients after major surgery. *Crit Care Med* 2008;**36**:1768–75.
- Hasten DL, Pak-Loduca J, Obert KA, Yarasheski KE. Resistance exercise acutely increases MHC and mixed muscle protein synthesis rates in 78–84 and 23–32-year-olds. *Am J Physiol Endocrinol Metab* 2000;**78**:E620–6.
- Howard L, Malone M. Clinical outcome of geriatric patients in the United States receiving home parenteral and enteral nutrition. *Am J Clin Nutr* 1997;**66**:1364–70.
- Norman K, Pichard C, Lochs H, Pirlich M. Prognostic impact of disease-related malnutrition. *Clin Nutr* 2008;**27**:5–15.
- Oz V, Theilla M, Singer P. Eating habits and quality of life of patients receiving home parenteral nutrition in Israel. *Clin Nutr* 2008;**27**:95–9.
- Brandstrup B, Tønnesen H, Beier-Holgersen R, Ørding H, Lindorff-Larsen K, Rasmussen M, et al. Danish Study Group on Perioperative Fluid Therapy. Effects of intravenous fluid restriction on postoperative complications: comparison of two perioperative fluid regimens. A randomized assessor-blinded multicenter trial. *Ann Surg* 2003;**238**:641–8.
- Dissanaike S, Shelton M, Warner K, O'Keefe GE. The risk for bloodstream infections is associated with increased parenteral caloric intake in patients receiving parenteral nutrition. *Crit Care* 2007;**11**:R114.
- Chen HS, Wang FD, Lin M Lin YC, Huang LJ, Liu CY. Risk factors for central venous catheter-related infections in general surgery. *J Microbiol Immunol Infect* 2006;**39**:231–6.
- Bozzetti F, Mariani L, Bertinet DB, Chiavenna G, Crose N, De Cicco M, et al. Central venous catheter complications in 447 patients on home parenteral nutrition: an analysis of over 100,000 catheter days. *Clin Nutr* 2002;**21**:475–85.
- Walshe C, Phelan D, Bourke J, Buggy D. Vascular erosion by central venous catheters used for total parenteral nutrition. *Intensive Care Med* 2007;**33**:534–7.
- Crook MA, Panteli JV. The refeeding syndrome and hypophosphataemia in the elderly. *J Intern Med* 2005;**257**:397–8.
- Crook MA, Hally V, Panteli V. The importance of the refeeding syndrome. *Nutrition* 2001;**17**:632–7.
- Bakker H, Bozzetti F, Staun M, Leon-Sanz M, Hebuterne X, Pertkiewicz M, et al. Home parenteral nutrition in adults: a European multicentre survey in 1997. ESPEN-Home Artificial Nutrition Working Group. *Clin Nutr* 1999;**18**:135–40.
- Lloyd DA, Vega R, Bassett P, Forbes A, Gabe SM. Survival and dependence on home parenteral nutrition: experience over a 25-year period in a UK referral centre. *Aliment Pharmacol Ther* 2006;**24**:1231–40.
- Van Wigcheren PT, Onwuteaka-Philipsen BD, Pasman HR, Ooms ME, Ribbe MW, Van der Wal G. Starting artificial nutrition and hydration in patients with dementia in the Netherlands: frequencies, patient characteristics and decision-making process. *Aging Clin Exp Res* 2007;**19**:26–33.
- Van der Steen JT, Kruse RL, Ooms ME, Ribbe MW, van der Wal G, Heintz LL. Treatment of nursing homes residents with dementia and lower respiratory tract infection in the United States and the Netherlands: an ocean apart. *JAGS* 2004;**52**:691–9.