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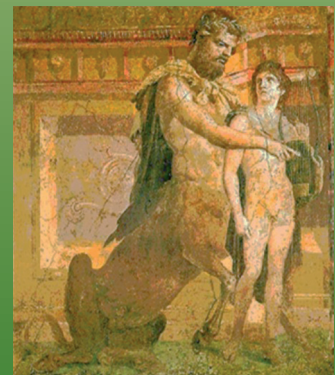


ITALIAN WOUND CARE ASSOCIATION
(ASSOCIAZIONE ITALIANA ULCERE CUTANEE - AIUC)

NUTRITIONAL TREATMENT IN PATIENTS WITH PRESSURE ULCERS

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PRESENTATION

It is a pleasure and an honour to present this position paper for the AIUC on "Nutritional treatment in patients with pressure ulcers".

The paper is an important piece in the cultural mosaic the Association is aiming to construct with a view to offering constant updates and food for thought to its members and all those care workers occupied in the management of the pathology of skin ulcers.

The authors have prepared a work programme with great methodological severity, combining opinions and citations with an abundant up-to-date bibliography.

Emerging loud and clear from these pages is the invitation (and it can never be repeated often enough) to take a holistic view of the pathology and consider the patient in his or her entirety.

Nutrition is a fundamental aspect of the treatment of patients with pressure ulcers: the supply of energy, proteins and amino acids, fluids, vitamins and minerals in doses that are often by necessity higher than those required by the healthy individual, forms part of the therapy, just like topical treatment and even more so.

The prescription of correct nutrition is a duty for the physician; to be correctly nourished is a right of every patient. The authors have done very well to underline the ethical implications such a therapy involves.

The choice of presenting topics in question form, with synthetic, summary recommendations, makes for easy reading and consultation. The readers enter this world progressively and see their curiosity, questions and need for further information satisfied. We might say they are taken by hand, like children.

And it is not without significance that the final chapter, which reviews the basic principles of the entire document, is dedicated to children: attention to detail in a general overview right from the earliest days of life.

A thank you from my heart to Giuseppe, Maria Stefania, Emanuele, Guido, Marco, Carlo, Oreste and Georgios for their competence and sensitivity.

GIORGIO GUARNERA
Presidente AIUC

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INTRODUCTION

Over the years, malnutrition has frequently been considered a predisposing factor in the onset of pressure ulcers, or an obstacle in the way of their cure. Nutrition is unquestionably one of the few variables that can be modified in patients with PU. Moreover it can affect prognosis, quality of life, rehabilitation and the cost of treatment for many patients. And yet reports in the literature on PU and nutrition often appear contradictory. The availability of risk assessment instruments for the nutritional status in patients with PU is extremely limited and the use of nutritional therapy is underrated. In Italy, for example, no reference document is available on PU and nutritional status.

The Steering Committee of this position paper is represented by the members of the AIUC study group. The paper is subdivided into one part dedicated to adults, prepared by Giuseppe Benati (Forlì), MariaStefania Bertone (Pisa), Emanuele Cereda (Pavia), Marco Masina (Bologna), Carlo Pedrolli (Trento), Oreste Sidoli (Parma) and Georgios Vertsonis (Bologna); and one part dedicated to children prepared by Guido Ciprandi (Roma).

The Steering Committee prepared the work agenda and the resulting programme. The research was carried out in the period January 2010 - January 2011. Papers in Italian, English and French were considered. Databases examined: Medline, Embase, PubMed, Cochrane. Analyses covered: original papers, guidelines, recommendations, case reports, reviews, RCTs, observational studies. The main keywords used were: malnutrition, nutrition, diet, nutritional support, artificial nutrition, enteral, parenteral, wounds, pressure ulcers, decubitus, bed sore, children, neonates, intensive care unit, diet, supplementation, oral intake. We also considered journals of particular interest and the documents of scientific societies.

During the IX National Congress of the AIUC the conclusive paper was presented for final agreement and then approved by the Executive Council.

The information collected by the authors on artificial nutrition should be considered with respect to the issues mentioned in the "Carta della qualità e dei diritti delle persone in nutrizione artificiale" - "Charter of the quality of life and rights of people receiving artificial nutrition" (Cittadinanzattiva Toscana Onlus 2009): right to healthy food; right to exercise the principle of independence, using the power of free, conscious decision; right to respect for their personal will; right to receive artificial nutrition at home within the context of dedicated functional structures; right to pass from natural to artificial nutrition and vice versa; right to use qualified centres specialising in clinical nutrition, set up in regional networks; right to artificial nutrition of quality; right to the best quality of life possible for people receiving artificial nutrition at home.

ADULTS

CHAPTER ONE

WHAT INFLUENCE DOES NUTRITIONAL STATUS HAVE ON PRESSURE ULCERS?

Should the risk factors for pressure ulcers be considered as an expression of a local condition or should they be classified holistically in the context of the patient's general condition and pathologies?

The definition of PU by the National Pressure Ulcer Advisory Panel (NPUAP) and the European Pressure Ulcer Advisory Panel (EPUAP) identifies responsibility for local damage to the skin and/or underlying tissues, generally above a bone prominence, as the effect of pressure or a combination of pressure and shearing. The definition concludes by stating that there are other factors whose significance remains to be clarified. The patient at risk is a patient who as a result of a pathological state presents general factors such as hypomobility or reduced motor capacity or local factors

(such as friction, slipping, humidity, blood hypoperfusion, oedema) that expose him to a greater extent to the onset of pressure ulcers. The NPUAP/EPUAP guidelines suggest that the risk factors identified in individual patients should request an individualised plan of assistance to minimise the effect of these variables, shifting the attention of caregiver from the skin to the patient in a global approach. (NPUAP/EPUAP board 2009).

What other factors apart from reduced mobility should be considered in assessing the risk of each patient?

Epidemiological studies and multivariate analyses have taught us a lot about other risk factors which are often not only local but related to the patient and to his systemic clinical conditions; the EPUAP/NPUAP guidelines recommend a global assessment which comprises the following factors:

- age;
- nutritional indices: anaemia, levels of haemoglobin and serum albumin, measurement of nutritional intake, weight;
- factors linked to perfusion and oxygenation: diabetes, cardiovascular instability;
- use of noradrenalin, low pressure values, ankle brachial index, use of oxygen;
- skin humidity: skin dryness and anhydrosis, excessive humidity and oedema are all risk factors;
- friction and shearing (detail on the Braden scale);
- sensory perception and skin sensibility (detail on the Braden scale);
- general clinical conditions;
- body temperature.

In addition to these conditions literature reports other pathological conditions and symptoms that can favour the onset of pressure ulcers or impede their cure:

- cardiovascular diseases;
- diabetes;
- oncological pathologies;
- malnutrition;
- immune deficiencies;

- peripheral vasculopathies;
- neurological pathologies;
- fever;
- concomitant and systemic infections (sepsis).

Does nutritional status influence the risk of developing pressure ulcers?

A correlation has been found between onset of pressure lesions and the presence of nutritional deficiencies, especially if they include a low protein supply and hypoalbuminaemia; patient history and clinical examination must therefore include assessment of the nutritional status (Bergstrom 1992, Berlowitz 1989, Langer 2003)

Should nutritional status be considered alone or together with other risk factors in the prevention and treatment of a patient?

There is an extensive overlap between nutritional deficiency risk factors and pressure sore risk factors. Nutritional deficiency and/or malnutrition should be investigated carefully in patients at risk of pressure lesions. Decubitus risk scales which include food intake assessment (Braden scale) and validated scales which explore nutritional status are strongly recommended since slight nutritional deficiency is a reversible risk factor, whose early recognition and treatment reduces the onset of lesions (NPUAP-EPUAP board 2009).

Can malnutrition explain why the incidence of pressure ulcers grows in parallel with the age of patients?

In addition to being a non-modifiable risk factor for the onset of pressure ulcers, advanced age is a condition with a high risk of malnutrition. The elderly patient (>75) is more at risk of hypo- and/or malnutrition than the younger patient and thus requires a personalised, specific nutri-

tional plan. In the elderly population the levels of malnutrition range between 23 and 85% (Shaver 1980), while mortality is correlated with a low Body Mass Index (BMI) (Tayback 1990). Age is a non-modifiable critical factor, a consequence of the higher frequency of chronic diseases, periods of hospitalisation or institutionalisation, the higher intake of anorectic drugs, less physical activity and modification in body composition (reduction in lean body mass, increase in total body fat, reduction in bone density and reduction in total body water (ASPEN Board of Directors 2002, Office of technology assessment 1996). In the chronically undernourished elderly, hypoalbuminaemia and/or hypocholesterolaemia are markers of extreme clinical gravity and at times predictive of high risk of death (Herrman 1992, Ferguson 1993, Sahvoun 1996). In these patients catabolism predominates in which gluconeogenesis uses certain dietary amino acids and muscle proteins for energy purposes.

— The loss of muscle mass (sarcopenia) takes on special significance in the elderly, especially in presence of systemic diseases, surgical operations or, more generally, of chronic inflammatory stimuli that determine increasing in metabolic needs for the maintenance of homeostasis and the synthesis of visceral proteins.

The association of immobility, loss of lean body mass (muscular and cutaneous) and immune system deficiency increases the risk of pressure ulcers by 74% (Horn 2004).

Practical recommendations

— *Wound management must consider strong strategies targeting the treatment of general wound-predisposing factors or factors that can delay their cure.*

— *The treatment of malnutrition or its risk correction must be considered in wound management.*

— *It is recommended that this should be performed in every patient with PU but especially in certain categories that are particularly at risk such as the elderly.*

CHAPTER TWO

HOW CAN MALNUTRITION BE DIAGNOSED IN PATIENTS WITH PRESSURE ULCER?

The relationship between malnutrition and PU is biunivocal in the sense that many malnourished patients present PU and many patients suffering from PU are malnourished. A recent study (Meijers 2008) shows that it is very important for acute and postacute/chronic patients to adopt a nutritional guideline in its approach to patients with PU. We now have many nutritional markers associated with the risk of developing PU. These include involuntary weight loss, protein energy malnutrition (PEM), dehydration (Lyder 2008), a low body mass index (BMI) (Hom 2004), reduced calorie intake (Bergstrom 2005), and a reduced eating autonomy.

Can we consider patients suffering from PU to be malnourished by default?

In a prospective study of 484 geriatric patients carried out within 48 hours of their admission to hospital, 42.9% of patients suffering from PU proved to be malnourished (BMI < 20 Kg/m²) while only 15.2% of patients not suffering from PU were malnourished (Hengstermann 2007). In the same study, however, more than 50% of patients with PU were not malnourished. An even earlier study involving higher numbers (Horn 2004) showed in subjects at risk of PU or with PU already present that only in 50% had there been a weight loss of 5% in three months and that the BMI was lower than/equal to 22 Kg/m² in 45.6% of the subjects studied. In a recent Japanese study (Iizaka 2010) out of 290 patients with PU as many as 238 (70.6%) received nutrition distributed over at least three meals and this was considered “adequate” in the three days of the assessment. These data therefore suggest that a nutritional assessment in patients with PU or at risk of PU is fundamental since to

consider everybody with PU to be malnourished would mean unjustly treating about 50% of patients for malnutrition. At the time of writing, therefore, we cannot consider patients with PU to be malnourished by default. It must be stressed, however, that recent studies highlight the fact that patients with PU present reduced protein energy intake, significantly lower than estimated needs (Cereda 2010; Shahin 2010). This deficit could, however, contribute to the onset of a malnourishment picture especially in the light of the fact that PU itself may be directly responsible for an increase in energy needs (Cereda 2010). It is therefore fundamental to carry out nutritional screening at the moment a PU is identified.

Is there a particular nutritional screening test you could suggest at the moment a PU is discovered?

The white paper on nutritional aspects of PUs mentions as a possible screening tool the Mini Nutritional Assessment (MNA) (Hudgens 2004) or the Malnutrition Universal Screening Tool (MUST) (BAPEN 2008). A recent review identified 71 tools for nutritional screening (Donini 2007), 21 of them created for use in the geriatric population. Of these the European Society for Parenteral and Enteral Nutrition (ESPEN) selected the MNA for the geriatric population (Kondrup 2003). The characteristic of the MNA is that it has high sensitivity and good specificity, respectively from 100% to 73% and from 98% to 26%, it is very reproducible and is easy and quick to administer even by nurses. Based on 18 items (Guigoz 2006), this tool also investigates many of those parameters that have been seen to be associated with the presence of PU (BMI, dietary habits, cognitive and functional status, immobilisation). In the same paper, the ESPEN indicated the use of the MUST with particular reference to the local population; this too has been proved to be highly reliable. The ESPEN indicated the NRS-2002 (Kondrup 2003) as a tool for the screening of hospital malnu-

trition. This associates the same nutritional components as the MUST with a grading of the severity of the disease in relation to increased metabolic needs (Kondrup 2003, Cereda 2009).

If nutritional screening in a patient with PU is positive, what nutritional assessment do you propose?

By nutritional assessment we mean a very accurate examination of nutritional, metabolic and functional variables carried out by an expert clinician, a dietician or a nurse with particular expertise in nutrition (Kondrup 2003); the purpose of the nutritional assessment is to arrive at a personalised therapeutic plan (natural and/or artificial) once malnutrition has been confirmed.

Nutritional assessment in the event of suspected malnutrition in a patient suffering from PU should include:

- an accurate clinical history providing information on weight loss, appetite, gastrointestinal symptoms, fever, drugs prescribed and/or utilised; recent studies not yet published (Sahim 2010) show that loss of weight expressed in kg in a period of time is a crucial element; social information is often important (family make-up, economic status, social relations, autonomy, dementia if any, ability to cook etc.) (ADA 2000). Information on food consumption is often collected by dietary clinical reports (food diaries, at times by way of the so-called 24h recall technique - Green 1999), or employing Food Frequency Questionnaires (FFQ) (Donini 2005) and a systematic, routine evaluation of these is recommendable in terms of both diagnosis and prevention (Cereda 2010);

- state of the disease(s); measurement of physical parameters such as body temperature, anthropometric measurements such as weight, height, derivative indices like BMI expressed in Kg/m² are very important but also and above all measurements of the inflammatory state such as white cells, albumin, C-reactive protein; there is often

little correlation between plasma proteins and nutritional status (Ferguson 1993); the quantification of fistula losses is very important and often ignored (Lloyd 2006);

— functional assessment: physical and mental dysfunction associated with malnutrition should be assessed; it is possible to assess muscular strength qualitatively, for example, by shaking a patient's hand, or quantitatively by using a dynamometer (Cereda 2008); in elderly functional assessment should be completed with a validated test for mental state evaluation (Folstein 1975);

— laboratory test: biochemical nutritional assessment has the following purposes (Omran 2000): select patients who will draw benefit from nutritional support; identify micronutrient deficiencies; identify baseline values that make it possible to monitor long-term effectiveness of nutritional support. We cannot, however, ignore that at times biochemical parameters and nutritional score tests are not in agreement (Covinsky 2002).

Practical recommendations

— *In spite of the absence of any strong evidence that the patient with PU is malnourished by default, such patients are certainly to be considered to be at high risk of malnutrition.*

— *On first examination the assessment should always consider the adoption of a formal screening instrument for malnutrition. An integrated assessment of present and future protein-energy intake (% with respect to estimated values) should be considered on a routine basis.*

— *The screening instrument to be adopted should be chosen on the basis of the assistance setting in which we are operating and on the real application of the instrument.*

— *In the event of a positive screening test, a specific nutritional process should be undertaken including the activation of a specialist team, where present, for a second level assessment and the identification of a treatment plan.*

CHAPTER THREE

DOES NUTRITIONAL THERAPY IMPROVE THE NUTRITIONAL STATUS OF PATIENTS WITH PRESSURE ULCERS?

What is meant by nutritional support?

Nutritional support can be defined as a set of dietary, pharmacological and artificial nutrition (enteral and parenteral) strategies aimed at preventing a deterioration of nutritional status and preventing or treating a state of malnutrition through the combined administration of protein and non-protein calories (ESPEN Guidelines 2006, SINPE 2007).

In most cases the organisation and management of nutritional support demands a specific competence. Transit from theory to practice is critical. Correct prescription is certainly not sufficient. Effective administration of the nutritional therapy must be verified.

Why should we consider the role of nutritional support in the improvement of the nutritional status of patients with PU?

Although a cause-effect relationship has never really been defined, the presence of PU has frequently been found in association with a condition of malnutrition. A demonstration that a nutritional approach can lead to an improvement in nutritional condition in association with a quicker healing process could indirectly support the importance of considering this therapy as one of the hinges of the cure process (NPUAP-EPUAP board 2009, Shahin 2010, Stratton 2005) as well as adding credence to the role of malnutrition in the development of PU's.

What patients are candidates for nutritional therapy and what role does nutritional status have in this choice?

Nutritional therapy should always be considered for patients with and without

PU and at nutritional risk currently malnourished (Kondrup 2002, ESPEN Guidelines 2006, SINPE 2007):

- severe malnutrition in association with insufficient food intake (< 60% of estimated need)

- moderate malnutrition and food intake likely to be insufficient for > 5 days

- slight malnutrition and food intake likely to be insufficient for >7-10 days

- severe catabolism in association with insufficient food intake

- moderate catabolism and food intake likely to be insufficient for > 5 days

- slight catabolism and food intake likely to be insufficient for >7-10 days.

Systematic reviews have shown that only in patients with malnutrition or at risk of malnutrition is it possible to obtain a significant reduction in mortality and an increase in body weight (Milne 2009).

In normally nourished patients nutritional therapy does not seem able to produce the same effects. Nevertheless, recent studies have shown a positive effect of protein-energy supplements and trace elements in the healing process of patients with PU even in the presence of a normal nutritional status (Schols (a) 2009, Schols (b) 2009).

As malnutrition is often accompanied by the presence of PU, the indication is to always act to correct the situation or to prevent a state of protein-energy depletion (Kondrup 2002, NPUAP-EPUAP board 2009; SINPE 2007).

Does the patient with PU present increased energy needs?

On the basis of the literature available, it is reasonable to imagine that PU is responsible for an increase in energy needs (Alexander 1995; Aquilani 2001; Dambach 2005, Liu 1996, Sergi 2007, Cereda 2010).

Few studies have attempted to assess the energy expenditure at rest of the patient with PU by means of the indirect calorimetry technique. Nevertheless, in spite of the heterogeneity of the patients studied, there is almost unanimous agreement that PU pa-

tients show a significant increase in energy expenditure normalised for body weight with respect to controls (23.7 ± 2.2 kcal/die vs. 20.7 ± 0.8 kcal/die). Only a study carried out on a heterogeneous population of elderly hospitalised cases showed comparable values between patients with PU and controls (Dambach 2005). Undoubtedly the presence of PU determines the activation of an inflammatory state which contributes to sustaining a hypercatabolic condition (Cordeiro 2005, Gurcay 2009). It is also fundamental to stress that the cutaneous lesion is itself a cause of the loss of nutrients and, in particular, of proteins (Iizaka (a) 2010, Iizaka (b) 2010). Although this loss does not seem to be directly correlated to nutritional parameters, its extent has proved proportionally correlated to the gravity of the ulcer. However, the long-term effect on nutritional status has never been studied.

In the light of these findings, if it is considered that patients with PU present a reduction in calory intake (Shahin 2010, NPUAP-EPUAP board 2009, Liu 1996, Sergi 2007), the direct consequence is that very often the protein-energy requirement is not covered. It is therefore correct to recommend that an effort should be made in this direction.

In agreement with the international guidelines recently published by the NPUAP and EPUAP, the systematic review of studies available in the literature suggests that the minimum daily calory need should be quantified in 30 kcal/kg/die (Cereda 2009; NPUAP-EPUAP board 2009; Cereda 2010). Compared to estimated protein-energy intakes it is reasonable to consider that a nutritional support of about 400 kcal/die can usefully contribute to achieving this purpose.

What nutritional support should be provided to improve nutritional status?

Considering the clinical and nutritional characteristics of patients with PU, and considering also the role and importance of nutritional intervention, it is reasonable to sustain that the most adequate support

we can provide for the patient is of combined protein-energy type. In agreement with ESPEN and SINPE (Società Italiana di Nutrizione Parenterale ed Enterale) guidelines, the way of administration should be selected on the basis of the willingness and tolerance of the patient, his degree of awareness and the practicability of the enteral route which advisedly always represents the first choice (ESPEN Guidelines 2006 e 2009; SINPE 2007). On the basis of these premises and in order to achieve the required protein-energy goals, the possibility should not be excluded of resorting to nutrition of mixed enteral-parenteral type.

How many calories should nutritional therapy provide to improve nutritional status?

It is reasonable to consider that the nutritional therapy PU patients should be quantified to cover their estimated daily calory need (30 kcal/kg/die) (Cereda 2009, NPUAP- EPUAP board 2009, Cereda 2010). However no studies have compared nutritional support calorie regimes in patients with PU with specific interest on nutritional status. No specific indications can therefore be provided. Recent metanalyses of studies on nutritional support in non-PU patients indicate that, in terms of body weight, a significant improvement in nutritional status is achievable in patients with irregular nutritional status (malnourished and/or at risk of malnutrition) through a minimum protein-calorie supply of about 400 kcal/die, support that would be capable of addressing the reduction in calory intake (Milne 2009). Duration of nutritional therapy with a positive energy balance is a crucial factor.

How long should nutritional support last if nutritional status is to improve?

At present there are no precise indications regarding the duration of nutritional support in order to achieve significant improvement in nutritional status. Published studies on nutritional interventions in PU

patients report an extremely variable duration (range: 1-12 weeks) (Cereda 2009, Myers 1990). Minimum duration could be considered about 4-8 weeks. Literature data suggest that the percentage reduction of 20-40% in the area of a chronic lesion during the first two-four weeks is a reliable predictive indicator of cure (Soriano 2004). It would also seem correct to suggest an extension of the nutritional intervention until complete resolution of the lesion or at least until it is no longer possible to detect any significant slope in the healing curve for ≥ 2 weeks. Finally, in cases where the lesion worsens when nutritional therapy is suspended, while adequate local treatment of the lesion is maintained, it is reasonable to consider a resumption of nutritional support.

On the basis of these therapeutic suggestions, in order to really benefit from nutritional support, it is finally extremely important to consider continuity in the nutritional regime every time the patient being treated is a candidate to transfer to a different clinical and assistance setting.

What parameters are used to define an improvement in nutritional status?

In the various randomised and non-randomised nutritional intervention studies, reports exist of modifications to a series of parameters to which reference is usually made to partially describe nutritional status (Holmes 1987, Breslow 1991, Myers 1990, Ek 1991, Breslow 1993, Bourdel-Marchasson 1997, Jackobs 1999, Benati 2001, Soriano 2004, Collins 2005, Desneves 2005, Heyman 2008, Cereda 2009). Although the information available is in fact limited, a trend towards an improvement in these variables can generally be observed. Nevertheless, the same variation is mostly described as non-significant.

As reasonably expected nutritional support determines a significant increase in calory intake which would seem to be maintainable even for periods of 8-12 weeks (Breslow 1993, Desneves 2005, Cereda 2009). This therapeutic result, howe-

ver, does not seem to be associated with a significant increase in anthropometric parameters (weight, body mass index, circumference and/or tricipital skinfold of the upper extremity) (Breslow 1993, Soriano 2004, Collins 2005, Cereda 2009) nor with biochemical-nutritional parameters (albumin, prealbumin, transferrin, haemoglobin, total proteins, cholesterol) (Breslow 1993, Collins 2005, Desneves 2005, Cereda 2009). Only one study reports an increase in the lymphocyte count (Cereda 2009). Another study reported a significant increase in the quality of life (Collins 2005), an outcome that proved to be associated with nutritional status in various chronic pathologies. These studies did not, however, consider a systematic assessment of nutritional status. It therefore cannot be excluded that nutritional support is able to produce a significant improvement in commonly measured nutritional parameters in the malnourished patient.

Practical recommendations

— *The nutritional intervention must contemplate all possible available treatments: dietological counselling, oral supplementation and artificial nutrition, whether enteral, mixed enteral/parenteral or total parenteral.*

— *Whatever form it takes, the nutritional intervention from the calorie viewpoint must be sufficient to cover estimated needs and/or positivise the energy balance; this is presumably possible by guaranteeing a minimum supply of 30 Kcal/kg/die.*

— *Candidates for artificial nutrition and the type of support to be provided must be selected among patients with PU according to the existing guidelines laid down by benchmark clinical nutrition units in cases where straightforward improvement in diet is not able to meet the patient's estimated needs. The use of oral supplementation and enteral artificial nutrition must prevail.*

— *It is likely that the duration of nutritional treatment will be at least 4-8 weeks. It is therefore important that all possible strategies for the continuity of the programme should be guaranteed even if the assistance and treatment setting changes.*

CHAPTER FOUR

DOES NUTRITIONAL THERAPY IMPROVE THE PROGNOSIS IN PATIENTS WITH PU AND WHAT ARE ITS POSSIBLE OBJECTIVES?

What do we know about diet and the prevention and/or healing of pressure ulcers?

In spite of all the reports in the literature, at the time of writing there are no validated studies relating nutritional deficiency to an increase in the incidence of PU (Clark 2003), the survival of certain categories of patients (for example with dementia) being treated with enteral nutrition by probe also in relation to the prevalence of PU (Sampson 2009), just as the roles of specific nutrients in the prevention of PU have not yet been clarified (Doley 2010). Consequently the force of the recommendations present in the main guidelines remains rather limited (Sidoli 2005). Despite this, given the difficulty in gathering evidence in this context (limited number of patients, multi-factorial aetiology, parachute effect), data available are significant and can provide precise indications concerning the behaviour of the clinician and malnutrition, which should be considered an independent variable to be treated, also to prevent cutaneous pathology.

What do we know about the use of oral supplements and the healing of PU?

As early as 2000 an RCT (Bourdel-Marchasson 2000) reported that the use of nutritional supplements can contribute to preventing the development of PU, a study that has been regularly mentioned and cited by other authors (Reddy 2006). Another paper published in 2004 by Horn examined the treatment and functional characteristics associated with PU in patients in long-term care wards. The use of standard oral nutritional supplements proved to be associated with the diminution in the probability of developing PU.

The use of specific hyperproteic and hypercaloric oral supplements for the treatment of PU was found to bring about an improvement (27% of recruited patients had already taken oral supplements previously) in PU (stage II-IV lesions prevalently present at the sacrum and heel) on the basis of monitoring and measuring the area of the lesions (Heyman 2008). In any case, the characteristics of the studies carried out up to the present have not allowed us to offer certain proof, thus conditioning the quality of the findings and, consequently, the force of the respective recommendations.

What do we know about the use of tube feeding with respect to the healing of PU?

A systematic review carried out in 2005 found that enteral nutritional support with a high protein supply can significantly reduce the risk of developing PU (even by as much as 25%) (Stratton 2005).

What do we know about the use of specific nutrients with respect to the healing of PU?

A specific *vs* standard nutritional support for the treatment of PU in the institutionalised elderly was analysed in a controlled, randomised experimental study (Cereda 2009): the percentage of PU healings was seen to increase when a specific nutritional formulation was administered thus making this formula preferable to a standardised one.

It should be added that literature also provides significant data concerning the effectiveness of specific amino acids (arginine, glutamine) in the treatment of PU (Dorner 2009). Apart from the basic concept of metabolic source or proteinic precursors (Curi 2005), there is considerable evidence of the positive role of these pharmaconutrients (Clark 2000) as regards nutritional status and maintenance of lean body mass.

It has been shown that maintenance of high levels of glutamine is the major regulator of muscular proteolysis and also affects activity of the immune system and intestinal function (Wernerman 2008). Arginine is metabolised to urea and ornithine by arginase-1, generating proline, a substrate for the synthesis of collagen, and polyamine, which stimulates cellular proliferation. The positive role of this amino acid in tissue repair is also linked to metabolising by nitric oxide synthetase, with the production of nitric oxide and a further stimulus to lay down collagen, which strengthens the tissue repair (Curran 2005). Beta-hydroxy beta-methylbutyrate acts on muscular mass autonomously from these aminoacids, countering stimuli promoting cachexia and therefore loss of muscular mass (Clark 2000, Eley H 2007, Holecek 2008). The result of administering these pharmaconutrients to healthy volunteers, although these were limited in number, was to stimulate collagen production in cutaneous repair processes (Williams JZ 2002). In spite of this, in a Cochrane Review (Langer 2003) the authors were unable to indicate any definitive evidence. A later review (Theilla 2007) covering patients with critical pulmonary pathologies reported that administration of dietary products supplemented with EPA, GLA and vitamins A and C was associated with a significant reduction in the onset of new PU. A further analysis concerning the use of arginine and other micro-nutrient supplements showed positive effects as regards both healing and prevention for PUs (Schols 2009).

Practical recommendations

— *In spite of the difficulty in finding strong data, the literature on the cost-benefit ratio of nutritional treatment in patients with PU is full of evidence.*

— *A specific nutritional therapy able to stimulate tissue repair (glutamine, arginine, beta hydroxy beta-methylbutyrate, zinc) provides more significantly effective results than standard nutritional treatment, even though this requires further confirmation.*

— Together with the prevention and treatment of malnutrition, which represents an independent variable to be treated, therapy with pharmaconutrients using these nutrients must be part of a holistic approach adopted for patients with PU.

CHILDREN

What is the current clinical-biological concept of pressure ulcers in paediatric age?

“Pressure Ulcers are a serious iatrogenic injury in the acute care environment”.

This definition describes a complex lesion which corresponds to a pathological change in the vascularisation of the dermal tissues and whose onset in paediatric age is quicker than at any other age to the point of compromising extracutaneous and muscular tissues and the child's entire organism. In particular, PUs are localised areas of tissue destruction that develop when the soft tissues are compressed between a bone prominence and an external surface for a prolonged period of time (*European Pressure Ulcer Advisory Panel, EPUAP, 2003*). In the child this compression can be caused by a rigid part of the body (for example the auricular cartilage) which damages the underlying soft tissues.

In other cases, especially if the child is hospitalised in a “Critical”, or otherwise “Intensive” ward (area dedicated to immunodepressed/immunocompromised or oncological patients, or patients in intensive care or resuscitation, surgical or gastroenterological cases) the external surface may be a device (pO₂ probe, tracheostomic cannula, nasogastric probe), or a “cutaneous - cutaneous/musculofascial bridge”, as in the case of a surgically solidified entero- or tracheostomal tissue. In short, an otherwise therapeutic action can unfavourably influence cutaneous integrity where the treatment is badly managed.

Who is in fact the paediatric patient with PU, what risk scales are most commonly used and how did we begin to speak about Nutrition and Risk?

The attention dedicated to Planet Children with PU is very recent. Protocols of Skin Care began to appear only in the 1990s in specialised journals like “Pediatric Nursing”, “Journal of the Society of Pediatric Nurses” and “Journal of Pediatric Nursing”. In this period, at the same time, efforts were focused on the adaptation of the various Scales of Risk to a developing organism. Just think of the attention devoted to the various auxological moments that distinguish the **infant** (21days-12 months), newborn and unweaned, the **toddler** (12 – 36 months), a child taking its first steps, the **pre-school** child (3 – 5 years), a child attending the creche/nursery school and the **young school** child (5 – 8 anni), which needs no explanation. This age subdivision is centred on two criteria: the first means that at 3 weeks (the 21 days of the infant), the skin reaches a maturity that is almost comparable to that of a newborn at term, independently of the gestational age of birth. The second criterion pursues the parallelism between the different constants (well codified by Braden *et al.*) observed and adopted at the different stages of evolution and growth:

1. mobility and orientation in space;
2. motor activity, gestuality and walking;
3. sensitivity and development of the neurosensorial apparatus and the ability to respond to pain stimuli and at times to try to understand if and how the preterm and the newborn in particular respond to pain and what their pain threshold is;
4. cutaneous microenvironment and humidity, relationship with microvascularisation and with nourishment modalities of the most external layers of the epidermis;
5. surface attrition, slipping and friction, considering problems related to the higher concentration of water in newborn and unweaned baby tissues and to the faster oedematous skin response to various stimuli, including the infectious;
6. nutrition in terms of calories, water

supply, proteins, sugars, fats, vitamins, trace elements, local and systemic growth factors and the diversity of incidence on the skin of forced “therapeutic” diets such as the NPT and NP with their respective cycles;

7. finally, the perfusion of tissues, the oxygenation of tissues, the peripheral district metabolic supply and the disposal of catabolites.

Braden’s Scale adapted to paediatric age has thus become Braden’s Q* Scale (1996), where for each of the seven constants set out above there is a severity score from 1 (serious) to 4 (light). The cutoff, namely the critical point of transit from Stage I to Stage II is affected by the auxological criterion and was set at 23, in patients aged less than 6, and at 16 in patients aged more than 6. To cite the main diversities with adults, Braden’s Q Scale proposed the following modifications:

*“Q”, from the name of one of the authors, Quigley S.M.

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- Activity 4: those who can’t walk because of their age (4 = however... they walk frequently)
 - Humidity: 1=constantly wet, 2=nappy change every 8 hours, 3=change every 12 hours or once a day (%H₂O tissue, perspiratio insensibilis, urine, drainage)
 - Attrition 1: spasticity, contracture, pruritus, agitation
 - Nutrition 1: albumin<2.5mg/dl
-

How are the stage, tridimensional anatomic dimensions, prevention and speed of onset of PU related and interconnected in paediatric patients?

Having introduced the Stage concept we show here the most commonly used classification in the paediatric world in accordance with the criteria set out by the *EPUAP*.

— **Stage I:** skin area with persistent hyperaemia, change in warmth on palpation and/or in sensitivity, < consistency.

— **Stage II:** partial < thickness of the cutaneous layers, at times with involvement of the derma (superficial ulcer, abrasion), indurative erythema, absence of pain and necrosis.

— **Stage III:** involvement of the subcutis up to but not beyond the fascia. Crater, at times covered by eschar. Necrosis, undermined margins, fistulas, exudate, sometimes infection.

— **Stage IV:** deep tissue destruction that involves the fascia and muscle as far as the bone/joint. Deep craters, necrosis, fistulas, exudate, sometimes infection.

The printing of the word “craters” underlined must mean the intention of reducing the clinical and emotional impact this definition implies in children compared to the adult. A crater, in fact, indicates a lesion capable of reaching the deepest, subfascial layer to the point of uncovering a bone shelf, with the consequence of marked destruction of cutis, subcutis, musculofascial tissue, with or without infection. In paediatric age it is important not to “understage” the lesion, considering that in the child a crater can be much less deep because of reduced tissue thickness: Stage III in the child can in fact have the thickness of a plastic ruler, a house key or a 10 Euro cent coin.

What are the dimensions of the problem, what the risk factors, what the incidence of malnutrition?

From 3 to 5 hospitalised children out of 1000 present a pressure ulcer. Overall, if we consider the age parameter, 50% of cases of PU occur in pre-adolescence (below the age of 10). This incidence reaches 30%, however, if we only consider patients in Intensive Care Units (ICU) - Critical Paediatric Area (CPA). This area of extreme clinical and therapeutic interest (CPA) does not, however, only belong to a ward criterion but should be subdivided into three sectors according to the Class of Patients and the underlying Pathology, age (the critical newborn, 1-30 days) and the site of hospitalisation (ICU, Resuscitation, often including a patient undergoing Mechanical Ventilation).

Class Age and Site thus indicate a Critical Area that is more readily the target of PUs (Tables I, II, III).

TABLE I

CPA, Classes:
- Differently able
- Immobile (arthrogryposis, spastic...)
- Seriously mentally disabled
- Incontinent
- Surgical cardiopathies
- Bone marrow transplant and "spinal" children
- Malnourished, dysproteinaemic, micro-element deficiency states, hypo-dysvitaminosis

TABLE II

Risk criteria in newborns
- CEC
- ECMO
- Heart surgery
- Tracheal surgery
- Hypoxyaemia
- Hypoperfusion
- "Scarring Alopecia"

TABLE III

CPA: ICU
- ICU
- Mechanical ventilation
- Immobility
- Insufficient perfusion of the less noble tissues
- Severe cutaneous iatrogenous damage

30% of the patients admitted to the ICU present decubitus. Distinctive features are represented by Number, Site, Stage and Time. About 80% of patients present from 1 to 3 lesions and the remaining 20% have a number of sores varying from 4 to 12. It is interesting to note that in half the cases we observe only one lesion and that the group that presents more than 6 sores is tiny (1-5% of the total). In 85% of cases the child presents a Stage I-II and about half of all patients present a sore at the first Stage. In 35% of cases a Stage II-III involves the cranium (especially the neurocranium, lesions to the facial mass are rare). The areas most affected by a Stage III sore are the back of the head, the ear, the chest and the coccyx. One of the most interesting aspects regards timing, namely the time of onset of the sore starting from first admission to the ICU. Testifying to very quick onset, about 60% of sores appear as early as the first 48 hours

and 100% of lesions occur within the first 7 days of hospitalisation (Table IV).

TABLE IV

- From 1 to 3 sores (50%-1. 20%-2. 12%-3)
- More than 3 sores: 10-15% up to 6, 1-5% over 6
- 50% Stage I - 35% Stage II - 10% Stage III
- 35% of SII-SIII involve the cranium
- Areas SIII: back of head, ear, chest, coccyx
- 60% of sores are observed from Day 2 of the ICU
- 100% of sores by Day 8 of ICU

Because of the speed of onset and the particular dimensions of the head with respect to the body (1:3, with respect to the adult Vitruvian man according to Leonardo's well-known drawing) the rotational protocol includes a repositioning every 30' in the heated operating bed (patient immobile, seated, unconscious, insensitive and incubated) and every two hours in the ward bed.

The less common sites for bed sores represent about 20% of the total: these include above all scapula, sacrum, sternum and spinal column lesions. The body area most easily attackable by a pressure ulcer is the head (36%, occiput, ear, nostrils, parieto-temporal region), followed by the lower extremity (31%, hallux, ankle, heel, knee, infero-external surface of the thigh) and the back (19%, sacro-ileo-gluteal region, spinal column) (Table V).

TABLE V

Most frequent localisations for PUs	
- Occiput	20%
- Ear	15%
- Heel	11%
- Ankle	9%
- Hallux	9%
- Elbow	6%
- Coccyx	5%
- Iliac crest	5%

The heel does not have that dystrophic cutaneous component typical of the elderly and does not act as a fulcrum because of the short length proportionally of the lower extremity and because of the physiological flexion of the leg on the thigh, with the consequent external rotation typical of

babies. The hallux is the most frequent site used for the positioning of a pO₂ detector. The coccyx is virtually raised from the glutei and is therefore less frequently affected by pressure ulcer than in the adult.

Like the occiput, the spinal column can act as a fulcrum, particularly when it is constantly arched, as in the case of patients suffering from spasticity/rigidity and arthrogryposis. The neck, like the ankle, ventral side) and the knee can be affected by a decubitus above all in the first year of life, owing to the accentuation of physiological joint folds, above all in the course of localised or diffuse oedemas. In these cases the increase in local humidity and the onset of bacterial or mycotic infections facilitate the formation of a cutaneous breakdown and a consequent decubitus.

At this point we can state that Planet Children and the world of the adult have some points in common as regards PUs but also divergencies that justify a different diagnostic and therapeutic approach. Many useful lessons have been learned from adults with PU, adults who can be elderly, diabetic, chronically bedridden, hypotense, dystrophic, deficient. Starting from the study of common risk factors (Table VI).

TABLE VI

- Generalised oedema (> of pre-arteriolar space, <capillary/cell distance, <O ₂ diffusion, <available metabolites, >catabolite stagnation)
- Weight loss
- Malnutrition
- Multiorgan dyscrasia
- >period of immobility
- >PEEP over 10cmH ₂ O (>instability of patient and < period of mobilisation >risk of extubation)

Children's PUs are mainly located in the upper regions of the body, they appear acutely and rapidly, they are more visible and have cosmetic implications, they deserve aggressive prevention as early as Stage I. At times they are caused by chronic devices and are a severe daily commitment for nurses.

44% of children suffering from PU present clinical and biological signs of malnutrition.

At anamnesis what are the clinical signs of malnutrition to note in children with PUs? Can the main skin signs of nutritional deficiency in children be observed in patients with PUs?

Children who most often present a PU (55%) suffer from a neuromotor type disability, they are hospitalised in CPAs, they are often connected to a VM, they present unstable metabolic and respiratory balance and more frequently than others suffer from malnutrition. In any case, whatever the patient's age and his/her clinical history, certain signs/symptoms of hypo/malnutrition should always be investigated before proceeding to biochemical investigations and the dietary supplements appropriate to preventing a PU or accelerating cure: dry, desquamated skin. From the histopathological standpoint, exaggeration of the corneal layer corresponds to atrophy of the granulous layer and a reduction in collagen; swelling of the joints; reduction in muscular tone and tremors; reduction in calcium-dependent tone; dizziness and delayed or reduced amplitude reflexes; retarded growth; reduction in appetite; stomach dilatation; bleeding of the mucosa (especially buccal); reduction in immune indices and altered protein electrophoresis; diarrhoea; hair loss and onychodystrophy.

Various signs of cutaneous nutritional deficiency are observed more frequently in paediatric patients with PU. Insufficient growth often lower than 5%, periorificial or acral dermatitis, increase in local and joint oedema, as signs of protein, essential fatty acid, biotin, zinc and vitamin A deficiency are observed particularly in premature births, in children subjected to TPN for more than 1 year, in children with chronic inflammatory bowel disease or suffering from cystic fibrosis. Particularly in unweaned children and the under-5s with malnutrition, certain signs in skin adnexa, transitory alopecia, reduced scalp discoloration and hypochromotrichia should be better observed as they could well presage the formation of a PU (mostly occipital). In some

series, the presence of an area of occipital alopecia with a higher than 3 cm diameter could be classed as Stage 1 of Braden Q.

It is not a coincidence that in children the oxidative damage present at the level of a non-healing PU could be attributed to selective deficiencies of manganese, zinc and copper which form part of the constitution of those enzymes called superoxide dismutases which play an essential role in the prevention of pathologies with oxidative cell damage and consequent production of high levels of free radicals. The possible markers of protein nutritional status are albumin, transferrin, pre-albumin and retinal binding protein, as protein-losing enteropathies, renal and hepatic pathologies, dysmetabolisms and severe infections have to be excluded. Assessment of amino acid status is also essential as some chronic PUs can benefit from selective elements for a resumption of cure: the gold standard for the assessment of amino acid status in children is IAAO (indicator amino-acid oxidation).

What is the main role of clinical nutrition in children with PU? Physiopathology of events.

Children's skin receives a third of circulating blood (equal to 25ml/kg of weight in the adult and 70ml/kg in the newborn at term), with a percentage of H₂O equal to 75% of the weight of which about 87% interstitial fluids. Children with PU present dysproteinaemia (serous albumin levels <2.0 ml) that conditions an important oedema which, as in a vicious circle > friction and slipping actions, > prearteriolar space and > the distance between capillary network and cells, reduces the supply of tissue O₂ and so self-maintains the chronicity of PUs.

It will consequently be necessary to increase body weight, increase the thickness of the subcutaneous cell layer (cell and adipose tissue in support of the derma), prevent vitamin deficiencies, prevent Na, Cl, K, Mg deficiencies, prevent trace element deficiencies (zinc, copper, molybdenum, cobalt,

iron, manganese), prevent a consequential change in the immune status which is actively growing and maturing, with a consequent increase in energy expenditure.

In PU and malnourished children, the current approach is therefore to increase calorie intake and use a hyperprotein diet that reaches 2.5-3.0gr/kg, increase the arginin supply up to 15 g by inducing an increase in collagen synthesis and hence of granulation) > intake of proline and hydroxyproline, supplement supplies of ascorbic acid, carnitine, vitamins A, B, E, K, carotenoids zinc and Fe⁺⁺ with a 30% upgrading above the intake recommended by the Food and Drug Administration (pro kg/die). It should be considered that intakes will change with the administration route and that an iv approach will involve from 10% to 22% less than per os intakes. As for vitamins, administrations will be codified in accordance with a precise weekly protocol that takes account of the dose/age/weight ratio.

Practical recommendations

— PUs in paediatric age are not an infrequent event and their presence should be methodically sought from head to foot. The cataloguing of the risk and stage of PU must target the different development ages with validated instruments which currently always include the Nutrition variable, with a score from 1 (severe) to 4 (slight) on the Braden Q scale.

— The Glamorgan scale, which you need to know, can also be applied to study PU risk in children. With this instrument, the level of significance of the variables associated with PU is high ($p < .001$) because of the problems involving position, anaemia, extrinsic compression, reduced mobility, lengthy surgery, hyperpyrexia, peripheral hypoperfusion, low serum levels of albumin, weight lower than 10% and, of course, inadequate nutrition.

— The first action to be taken in every management protocol is a patient history and objective examination in order to note every slightest sign of hyponutrition, malnutrition or specific deficiency.

— PUs in children appear acutely and rapidly and therefore deserve aggressive pre-

— *vention right from Stage I with particular attention to devices. As 44% of children with PU present clinical and biological signs of malnutrition, calorie and vitamin supplements 30% higher than normal intake should be started in the event of severe oedema, serum albumin levels <2.0g/dl, PEEP>10cmH₂O, severe immobility, progressive weight loss.*

— *All clinical signs and symptoms of hypo-malnutrition should be investigated at skin and skin adnexa level. The biochemical markers of protein nutritional status should also be known.*

— *In children with PU and malnutrition, a hyperprotein diet reaching 2.5-3.0gr/kg is currently used; arginin intake is increased up to 15 g, and the intakes of prolin and hydroxyprolin, ascorbic acid, carnitine, vitamins A, B, E, K, and carotenoids zinc and Fe⁺⁺ are increased.*

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