

The importance of nutrition in wound healing

Wound healing is a complex process that follows a progressive three-step sequence; the inflammatory phase, proliferative phase and remodelling phase. It is possible that all of these phases will be active in the same wound at the same time (Thomas and Bishop, 2007) and the duration of each stage will be influenced, among other factors, by the nutritional status of the individual. This article focuses on the role of nutrition, and the benefits of protein supplementation, in the management of chronic wounds, with a focus on pressure ulcers.

KEY WORDS

- ▶▶ Oral nutritional supplement
- ▶▶ Protein
- ▶▶ Wound healing

The incidence of pressure ulcers is estimated to be approximately 4% in acute hospitals, and accounts for 4% of NHS expenditure (Bennett et al, 2004). However, with 20% of patients in long-term care facilities developing pressure ulcers (Voss et al, 2005), and up to 30% in the community (National Patient Safety Agency, 2010), this is not only a cause for concern in the acute setting: the overall cost of pressure ulcers to the health and social care system in the UK was estimated to be £1.77 billion for the year 2000 (Bennett et al, 2004). This economic burden will undoubtedly have risen with inflation, and is set to rise further as the population ages.

A large body of evidence demonstrates that nutrition and wound healing are intrinsically linked. Malnutrition – specifically undernutrition – is caused by a deficit of energy, protein and other nutrients, and adversely affects body form, function, and clinical outcomes (Elia, 2000). Malnutrition is a common and costly problem, with 3 million people at risk in the UK and a higher prevalence among older people (Elia and Stratton, 2009).

NUTRITIONAL RISK FACTORS

Chronic wounds can occur in any individual; however, older people are often most susceptible due to the increased incidence of mobility issues, incontinence, chronic health conditions, and malnutrition in this population. Some of the nutritional factors that predispose people to pressure ulcer development include

dysphagia, edentulous, decreased thirst response, involuntary weight loss (>5% in 1 month; >7.5% over 3 months; >10% over 6 months), and dependency on help for eating (Thomas and Bishop, 2007), all of which become increasingly common with advancing age.

Malnourished people do not have sufficient nutrients available to maintain and repair tissues. This leads to reduced “padding” from fatty tissue, poor skin condition (with lower resistance to the effects of shear and pressure), physical weakness, reduced activity, and oedema (Stratton et al, 2003).

NUTRITIONAL ASSESSMENT AND SCREENING

Malnutrition has been implicated in the development of pressure ulcers (Thomas, 2001; Banks et al, 2010) and the impaired healing of chronic pressure ulcers (Stratton et al, 2003; Harris and Fraser, 2004). In fact, the majority of patients admitted to hospital with stage III or IV pressure ulcers are malnourished (Guenter et al, 2000).

Malnutrition is a reversible risk factor for pressure ulcer development (European Pressure Ulcer Advisory Panel and National Pressure Ulcer Advisory Panel [EPUAP–NPUAP], 2009), therefore early identification and management of risk factors is of the utmost importance in the prevention of avoidable pressure ulcer development. The EPUAP recommends the screening and assessment of the nutritional status of every individual at risk of pressure ulcers in all healthcare settings using a valid and

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reliable screening tool. This recommendation is further supported by NICE (2006; 2012), which states that nutritional screening should be undertaken in all health and social care settings with a validated tool, such as the Malnutrition Universal Screening Tool (MUST; Todorovic et al, 2003). Screening should be repeated weekly for inpatients, and when there is a clinical concern for outpatients and care home residents. The presence, or identified risk, of a pressure ulcer should be considered a clinical concern and, as such, nutritional screening should be repeated weekly to ensure that the patient’s nutritional intake is adequate to meet the metabolic demands of wound healing (NICE, 2006). For those at risk of malnutrition, a management plan – such as that outlined in The Managing Adult Malnutrition Pathway (www.malnutritionpathway.co.uk) – should be implemented to ensure the nutritional requirements of the patient are met (Brotherton et al, 2012; NICE, 2012).

NUTRITIONAL NEEDS

Energy

The most energy-intensive process associated with wound healing is collagen synthesis (Medlin, 2012). In the absence of adequate and sustained energy from dietary carbohydrates, the body’s protein stores will be broken down and used as energy. Therefore, increased energy availability is essential for wound healing, although the level

of additional energy required will vary depending on the individual. Guidelines for those with pressure ulcers recommend an intake of 30–35 kcal/kg body weight/day (Clark et al, 2004). For example, a 60-kg person would require an intake of 1800–2100 kcal/day. This is a high energy requirement and nutritional strategies should be implemented to assist patients – particularly those with a reduced appetite – to achieve this level of intake.

Protein

Fat-free mass decreases with age and, as a result, the amount of endogenous protein used in daily protein turnover decreases. Thus, older adults (>65 years of age) require higher dietary intakes of protein per kilogram of body weight than younger adults (Thomas and Bishop, 2007). Inadequate protein intake has been shown to significantly delay wound healing by prolonging the inflammatory phase. There is also evidence to suggest that protein intakes above normal may be desirable in patients with illnesses in order to counteract increased protein losses (i.e. highly exuding wounds) and to encourage tissue repair (Cawood et al, 2012). A minimum protein intake of 1–1.5 g/kg/day is recommended for people with chronic wounds producing high exudate volumes (Clark et al, 2004).

Older adults are at risk of inadequate protein intake and 32–41% of women and 22–38% of men have been found to consume less than the recommended dietary protein allowance (Posthauer et al, 2013). Protein-deficient meals fail to deliver the amino acids necessary for the synthesis of more complex proteins, putting the individual at risk of loss of lean body mass, which is a risk factor for the development of pressure ulcers. If a patient loses 20% of lean body mass their muscles will compete with wounds for protein; if they lose $\geq 30\%$ of their lean body mass, the body will prioritise muscle maintenance over wound healing (Medlin, 2012). Inadequate protein intake, and increased protein requirements, result in a protein deficit (*Figure 1*).

Achieving recommended protein intakes by eating extra food can be extremely challenging, especially during periods of illness. In the example provided in *Figure 1*, the additional 40 g of protein

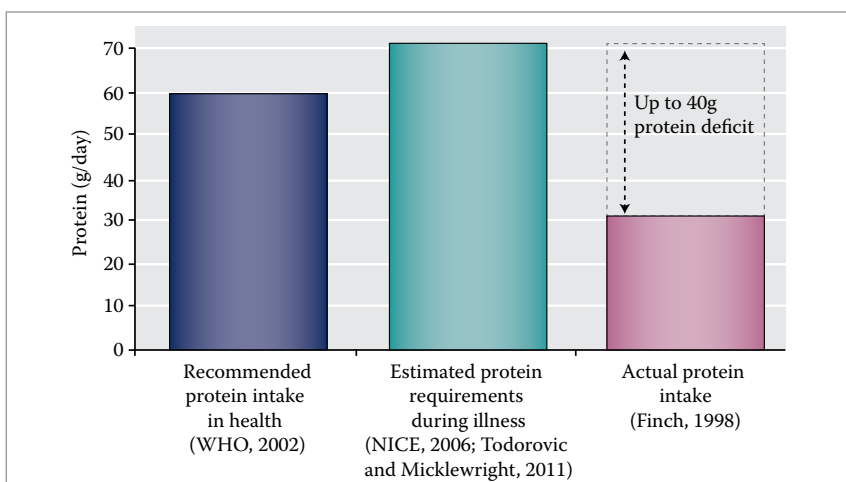


Figure 1. Protein requirements versus actual intake. Based on an example patient weighing 58 kg with a moderately increased protein requirement of 1.2 g/kg/day (Todorovic and Micklewright, 2011).

required by the average patient equates to the consumption of 6.5 eggs, or 2 pints of milk, or a 200-g rump steak each day, in addition to their usual dietary intake (Food Standards Agency, 2002). This is unlikely to be achievable or sustainable for the majority of patients.

Micronutrients

Vitamins A, C, and E, zinc, selenium, and magnesium play key roles in the prevention and attenuation of peroxidative damage and can potentially enhance wound healing (Thomas and Bishop, 2007). It is important to promptly identify and correct any micronutrient deficiencies in patients with wounds. The interpretation of micronutrient serum levels can be difficult and patients should be assessed by a dietitian to optimise their nutrition during wound healing.

Fluid

Fluid plays a role in the transportation of nutrients to where they are required (Medlin, 2012) and helps to maintain skin turgor. Dehydration can cause skin to lose its elasticity, becoming fragile and susceptible to breakdown and is, therefore, a major risk factor for the development of pressure ulcers (Horn et al, 2004). Older people who experience reduced mobility and urinary incontinence may intentionally reduce their fluid intake to manage their symptoms, placing them at risk of dehydration and, ultimately, pressure ulcers (Thomas and Bishop, 2007).

The EPUAP–NPUAP (2009) guidelines recommend a fluid intake of 1 mL/kcal/day for people at risk of pressure ulcers. Thus, someone with an energy requirement of 2000 kcal/day will require 2000 mL/day of fluid to meet their hydration needs. When calculating fluid requirements it is important to consider all routes of possible fluid loss (e.g. perspiration, wound exudate, watery stools, vomit, pyrexia), which will further increase patients' requirements.

NUTRITIONAL STRATEGIES

NICE (2006) suggests the use of various nutrition support strategies to improve dietary intake, such as food fortification and oral nutritional supplements (ONS). Food fortification tends to increase the energy content of the diet without

adequate provision of micronutrients (NICE, 2006), and many patients struggle to consume the volumes of food required to meet their nutritional needs. Patients who are unable to achieve their nutritional requirements through diet alone should be offered high-energy, high-protein (i.e. >20% energy from protein) ONS that contain a full range of vitamins and minerals (EPUAP–NPUAP, 2009). Wound strength is dependent on the formation and deposition of the protein collagen, therefore, the availability of amino acids through a high-protein supplement may facilitate healing.

A systematic review of nutrition in prevention and treatment of pressure ulcers demonstrated that the use of high protein ONS is associated with a significantly lower incidence of pressure ulcer development (25%) in at-risk patients when compared to routine care (Stratton et al, 2005). A more recent systematic review and meta-analysis of high-protein ONS showed that, in addition to diet and compared with controls, high-protein ONS can improve intake, weight and strength and show a significant reduction in hospital readmissions and complications (19% reduction). This review included patients with surgical wounds and pressure ulcers amongst others (Cawood et al, 2012).

Concerns have been raised about the adverse effects of excessive protein supplementation, usually in relation to bone health and renal function. However, the purpose of prescribing high-protein ONS is to increase protein intake from a low intake to a more desirable or normal intake. Evidence from a systematic review found no significant adverse effects of increased protein intakes over the course of the studies, where duration of supplementation was often ≥ 6 months (Cawood et al, 2012).

Poor ONS compliance and the impact of ONS on appetite have also been highlighted as concerns (Lad et al, 2005). However, the authors of a recent systematic review found that ONS compliance was good across a number of healthcare settings; in fact, compliance was higher with increasing ONS energy density (Hubbard et al, 2012), likely due to the smaller volumes needing to be consumed. ONS were also shown to have little suppressive effect on

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“...use of high-protein oral nutritional supplements is associated with a significantly lower incidence of pressure ulcer development...”

appetite or food intake, with the majority of ONS energy being additive to food and resulting in significant increases in total energy and nutritional intakes (Hubbard et al, 2012). For malnourished patients – in particular older patients who may be limited by the volume of food that they can comfortably consume – a range of energy- and protein-dense ONS are now available on prescription in the community.

SUMMARY

This review demonstrates the intrinsic link between nutrition and wound healing, and the need to ensure that macro-, micro-nutrient and fluid requirements are met in order to promote good skin condition, and maintain and repair tissues. Deficits in protein intake are directly associated with poor outcomes for patients and there is a case to consider higher protein requirements above the reference nutrient intakes to improve clinical outcomes. This may be provided effectively via the use of low-volume, high-energy, high-protein ONS that contains a full range of vitamins and minerals. **WUK**

REFERENCES

- Banks MD, Graves N, Bauer JD, Ash S (2010) The costs arising from pressure ulcers attributable to malnutrition. *Clin Nutr* 29(2): 180–6
- Bennett G, Dealey C, Posnett J (2004) The cost of pressure ulcers in the UK. *Age Ageing* 33(3): 230–5
- Brotherton A, Holdoway A, Mason P, multi professional consensus panel (2012) Managing Adult Malnutrition in the Community. Available at: <http://malnutritionpathway.co.uk> (accessed 01.08.2013)
- Cawood AL, Elia M, Stratton RJ (2012) Systematic review and meta-analysis of the effects of high protein oral nutritional supplements. *Ageing Res Rev* 11(2): 278–96
- Clark M, Schols JM, Benati G et al (2004) Pressure ulcers and nutrition: a new European guideline. *J Wound Care* 13(7): 267–72
- Elia M (2000) *Guidelines for detection and management of malnutrition. Malnutrition Advisory Group, Standing Committee of BAPEN*. BAPEN, Maidenhead
- Elia M, Stratton RJ (2009) Calculating the cost of disease-related malnutrition in the UK in 2007 (public expenditure only). In: Elia M, Russell CA (eds) *Combating Malnutrition: Recommendations for Action. A Report From The Advisory Group on Malnutrition, Led by BAPEN*. BAPEN, Redditch: 39–46
- European Pressure Ulcer Advisory Panel, National Pressure Ulcer Advisory Panel (2009) *Prevention And Treatment Of Pressure Ulcers: Quick Reference Guide*. NPUAP, Washington DC
- Finch S, Doyle W, Lowe C et al (1998) *National Diet and Nutrition Survey: People Aged 65 Years And Over. Volume 1: Report of The Diet And Nutrition Survey*. TSO, London
- Food Standards Agency (2002) McCance and Widdowson's *The Composition of foods* (6th edn). Royal College of Chemists, Cambridge

- Guenter P, Malyszec R, Bliss DZ et al (2000) Survey of nutritional status in newly hospitalized patients with stage III or stage IV pressure ulcers. *Adv Skin Wound Care* 13(4 Pt 1): 164–8
- Harris CL, Fraser C (2004) Malnutrition in the institutionalized elderly: the effects on wound healing. *Ostomy Wound Manage* 50(10): 54–63
- Horn SD, Bender SA, Ferguson ML et al (2004) The National Pressure Ulcer Long-Term Care Study: pressure ulcer development in long-term care residents. *J Am Geriatr Soc* 52(3): 359–67
- Hubbard GP, Elia M, Holdoway A, Stratton RJ (2012) A systematic review of compliance to oral nutritional supplements. *Clin Nutr* 31(3): 293–312
- Lad H, Gott M, Gariballa S (2005) Elderly patients' compliance and elderly patients' and health professionals' views and attitudes towards prescribed sip-feed supplements. *J Nutr Health Aging* 9(5): 310–4
- Medlin S (2012) Nutrition for wound healing. *Br J Nurs* 21(12): S11–2, S14–5
- National Patient Safety Agency (2010) NHS to adopt zero tolerance approach to pressure ulcers. Available from: <http://bit.ly/RM5EA7> (accessed 03.07.2013)
- NICE (2006) *Nutrition Support in Adults: Oral Nutrition Support, Enteral Tube Feeding And Parenteral Nutrition*. CG32. NICE, London
- NICE (2012) *Quality Standard for Nutrition Support in Adults. QS24*. NICE, London
- Posthauer ME, Collins N, Dorner B, Sloan C (2013) Nutritional strategies for frail older adults. *Adv Skin Wound Care* 26(3): 128–40
- Stratton RJ, Green CJ, Elia M (2003) *Disease-Related Malnutrition: An Evidence-Based Approach to Treatment*. CABI Publishing, Wallingford
- Stratton RJ, Ek AC, Engfer M et al (2005) Enteral nutritional support in prevention and treatment of pressure ulcers: a systematic review and meta-analysis. *Ageing Res Rev* 4(3): 422–50
- Thomas DR (2001) Improving outcome of pressure ulcers with nutritional interventions: a review of the evidence. *Nutrition* 17(2): 121–5
- Thomas B, Bishop J (2007) *The Manual of Dietetic Practice* (4th edn). Blackwell Publishing, London
- Todorovic V, Russell C, Elia M (2003) *The 'MUST' Explanatory Booklet. A Guide to The Malnutrition Universal Screening Tool (MUST) for Adults*. BAPEN, Redditch
- Todorovic V, Micklewright A (2011) *A pocket guide to clinical nutrition* (4th edn). BDA, London
- Voss AC, Bender SA, Ferguson ML et al (2005) Long-term care liability for pressure ulcers. *J Am Geriatr Soc* 53(9): 1587–92
- World Health Organization (2002) *Keep Fit For Life: Meeting The Nutritional Needs of Older Persons*. WHO, Geneva

DISCLOSURE

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