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BAPEN Symposium 1: Malnutrition in obesity

Nutritional screening: pitfalls of nutritional screening in the injured obese patient

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The introduction of the process of nutritional screening into clinical standards has been driven by the increasing awareness of the prevalence of undernutrition in acute and primary care, along with its associated morbidity and mortality. However, the increasing prevalence of obesity in the general population suggests that an increased number of patients admitted to hospital will be obese. Increased morbidity has also been reported in the injured obese patient and may be associated with poor nutritional support. This situation may occur because the profound metabolic disturbances accompanying trauma in this group are not recognised, and subsequent feeding practices are inappropriate. Screening tools currently classify patients by using simple markers of assessment at the whole-body level, such as BMI. Subsequently, patients are identified as at risk only if they are undernourished. Such comparisons would by definition classify injured obese patients as at minimal or no nutritional risk, and they would therefore be less likely to be re-screened. This approach could result in potential increases in morbidity, length of rehabilitation and consequent length of hospital stay. It is likely that the identification of potential risk in obese injured patients goes beyond the measurement of such indices as BMI and percentage weight loss, which are currently utilised by the majority of screening processes.

Nutritional screening: Nutritional assessment: Obesity: Injury

The inability to recognise patients who are undernourished or those who may subsequently be 'at risk' nutritionally is the root cause of consequent morbidity during hospital stay and delayed recovery after discharge. Although studies continue to highlight the high incidence of undernutrition in patients (McWhirter & Pennington, 1994; Edington *et al*. 2000), the increasing incidence of obesity in the general population (Finch *et al*. 1998) suggests that an ever-increasing number of obese patients will be admitted to hospital. Several studies have also revealed an increased risk of complications in obese hospitalised patients that may be the result of inappropriate nutritional support (Jeevanandam *et al*. 1991; Merion *et al*. 1991; Shikora & Jenson, 1997) in this group. This situation may be a consequence of inappropriate screening and/or nutritional assessment. Identifying injured patients who are at risk nutritionally and are also obese is likely to be an increasing challenge in the near future. To date, identifying nutritional risk has focused on undernutrition because of the recognition of disease-related malnutrition and its consequences. An increasingly popular strategy adopted to identify such a risk has led to the development of a number of nutritional screening tools.

Nutritional screening in the undernourished

Nutritional screening has increasingly been incorporated into clinical standards of care as a marker of best practice, in an attempt to inform nutritional management of patients admitted to hospital (Department of Health, 2003; NHS Quality Improvement Scotland, 2003). Screening tools have been introduced to inform care plans of patients in their journey, whether it is in acute, primary or intermediate care.

Two key criteria for any screening tool are sensitivity and specificity. Sensitivity has been defined as the ability of a screening tool to give a positive finding when the condition being investigated is present (Holmes, 2000);

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a true positive. Nutritional screening tools that screen for undernutrition should, therefore, be validated with high sensitivity in order for the condition to be identified. Specificity allows the identification of subjects being screened who do not have the condition screened for; a true negative. In screening for undernutrition, therefore, specificity allows appropriate allocation of resources and ensures those patients who are not undernourished will not be identified as such. Specificity and sensitivity are dependent on the criteria used for determining a nutritional risk score (and often interpreted as nutritional status). In a heterogeneous population screened by Burden *et al*. (2001) sensitivity was reported to range from 35 to 82% and specificity from 86 to 92%. In this study it is clear that the screening tool can identify patients at high risk of undernutrition (17%); however, the majority of patients were categorised as at moderate risk (50%) and the remaining patients (33%) at minimal or no risk.

With moderate nutritional risk it is generally accepted and recommended (Elia, 2003) that re-screening or monitoring should support this level of risk. This approach, of course, creates a huge demand on human and financial resources. The question of whether 50% of the patients in the elderly, medical and surgical directorates initially screened by Burden *et al*. (2001) would be re-screened, in addition to those patients being routinely screened on admission, is questionable. Implementation of such guidelines requires that screening tools are not only specific and sensitive but also reproducible and transferable. Although not exclusively so, traditionally the nurse has been the healthcare professional to undertake screening, which ultimately makes them pivotal in initiating appropriately-targeted nutritional intervention (e.g. dietetic referrals).

The accuracy of nutritional screening in determining nutritional risk may be compromised by the level of simplicity set in the tool in order to confer transferability between allied health professionals and nurses. When also considering cost in this equation, variables such as weight (if measurable) and BMI are likely to be those that inform assessment of nutritional risk and, as such, clinical decision making.

Limitations of screening tools in injured obese patients

In fulfilling the criteria for establishing screening tools (Cochrane & Holland, 1971) the current emphasis of early identification of undernutrition precludes any assessment of risk in obese patients. The precision and reliability of any screening tool assessing risk of undernutrition when applied to obese patients is likely to show these patients as having an acceptable nutritional status. This result would be indicated by poor sensitivity of the tool when categorised for the BMI of the subjects. Obese individuals do not appear undernourished and, therefore, the screening tool should not identify them as such. In addition, the use of nutritional screening tools developed for screening of undernutrition but used in obese individuals would provide a high level of specificity, indicating they do not appear to be undernourished, but a low sensitivity score, as they do not have the condition being investigated. Specificity and sensitivity are dependent on the criteria used for determining a nutritional risk score and these criteria are likely to be factors such as BMI, percentage weight loss, mid-upper arm circumference and recent energy intake.

Any cut-offs set and used in determining risk will be those indicative of nutritional depletion not overnutrition, therefore providing a consistency in assessing such risk in relation to undernutrition not in relation to obesity. These cut-offs may effectively be exclusion criteria for obese individuals who are screened. By definition, obese individuals will have BMI of >30 kg/m^2, and arm muscle circumference and triceps skinfold measurements are likely to be >75th percentile. On these grounds alone obese individuals may be categorised into minimal risk or no risk and excluded from the screening process, irrespective of whether this strategy is appropriate.

Other measures indicative of nutritional depletion may also be useful in determining nutritional risk and have been compared against scores derived from a screening tool in order to assess its validity. One such variable is unintentional weight loss. This variable may be considered clinically significant at a weight loss of only 5% over 3 months or 10% over 6 months. However, a cautionary note is illustrated in Table 1, which gives an example of how the risk of undernutrition may be classified differently in individual patients, even though they have lost exactly the same amount of weight and have the same clinical condition.

Similarly, in determining retrospective or prospective reduction in appetite or dietary intake in patients it cannot be assumed that the mechanisms operating in the obese patients are the same as those present in normal-weight individuals. In obesity there is clearly an uncoupling of appetite control (Tsofliou *et al*. 2003) and maintenance of normal body weight. The effects on appetite and intake in the injured obese may or may not be similarly uncoupled, possibly giving rise to a reduction in intake, but not cessation of intake as would occur in normal- or underweight individuals. There is a dearth of literature in this area that needs to be addressed if the injured obese patient is to be appropriately managed in the future.

Irrespective of whether nutritional screening is used for assessing risk of undernutrition or malnutrition in obesity, what must be remembered is that screening is not a means to an end, it is a way of informing the health care practitioner of whether a more objective nutritional assessment is required.

Table 1. Different classification of risk in normal and obese patients

	Patient A	Patient B
Height (m)	1·68	1·68
Weight loss (kg)	5	5
Normal weight (kg)	54	85
BMI (m/h^2)	19	30
Percentage weight loss in 3 months	7	4·5
Nutritional risk	Significant	Not significant

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Screening *v*. assessment in obesity

Screening can only indicate nutritional risk not actual nutritional status (Fig. 1). At best it is accurate at the level of the whole body, giving a general indication of nutritional risk in order to inform treatment and level of care. Assessment at the tissue level (level IV in Fig. 1) is the most appropriate for the determination of nutritional status and is essential for the purposes of evaluating the effectiveness of nutritional interventions. In assessing risk additional indices such as an indication of prospective dietary intake are also preferred. In order to produce a simple, sensitive and transferable nutritional screening tool that can be implemented within existing resources, only a few of the variables normally included in a full nutritional assessment are incorporated. When considering the general applicability of such markers in the context of accurate nutritional screening there is a general assumption that the same extent of accuracy exists within undernourished and overnourished individuals. This assumption may not be valid, and it may be over-simplistic to expect any one nutritional screening tool to work universally.

Determination of BMI and weight are commonly used as indices of obesity as well as indicators of undernutrition in screening tools. In obesity BMI is accepted as a measure of body fatness. However, variations may occur in percentage fat mass in individuals with a similar BMI (Deurenberg *et al*. 1999) because of differences in physical characteristics such as leg length and body build. This factor may be particularly relevant in specific ethnic groups, and it has been suggested that standards or cut-offs based on the obese Caucasian individual may not be appropriate for some populations (Lear *et al*. 2003).

Increases in hydration are associated with increased adiposity. Hydration levels in obese men (74·2 %) and women (76–77 %) are reported to be higher than those in their leaner counterparts (Albu *et al*. 1989). In relation to the total body this increase is proportionally greater within the extracellular compartment (Waki *et al*. 1991). These differences in hydration state are likely to contribute to greater errors in the measurement of body composition when level V, the whole body (Fig. 1), is employed, and thus can lead to overestimation of relative body fat (Deurenberg *et al*. 1989) and total body mass *per se*.

It is now recognised that obesity is associated with low-grade inflammation and the presence of inflammatory markers such as C-reactive protein and pro-inflammatory cytokines (e.g. TNF-α), and these factors appear to correlate with BMI (Rawson *et al*. 2003) and body fat. Such a subclinical inflammatory state provides the biochemical

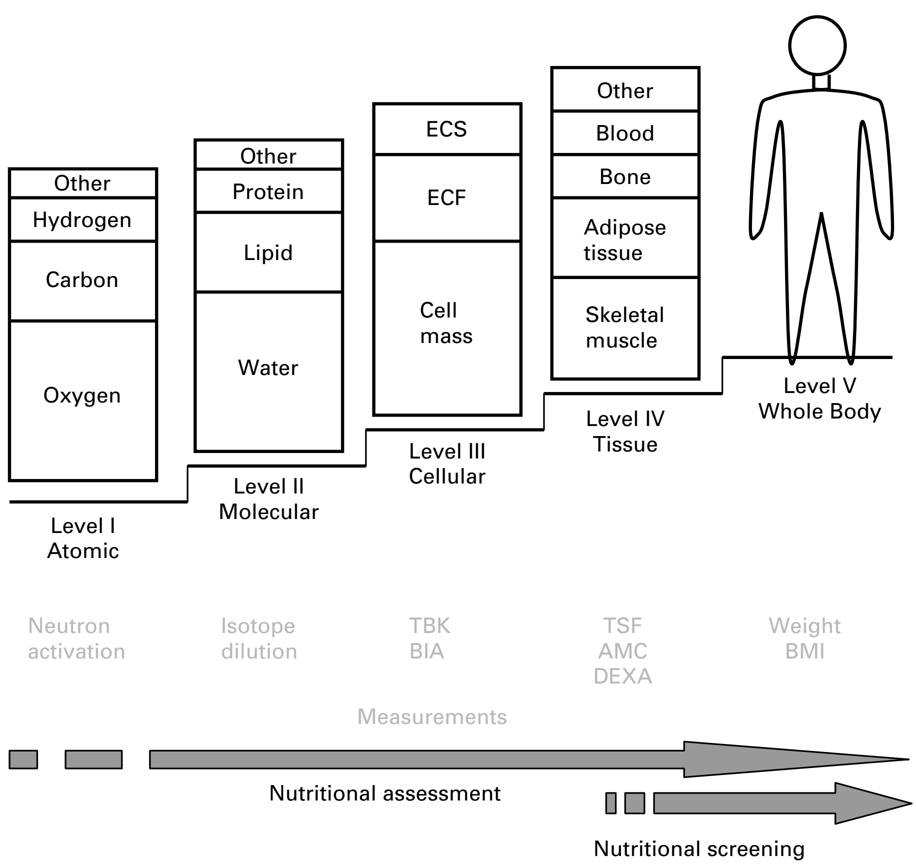

Fig. 1. The five-level body composition model and its relationship with measurements used for nutritional screening and assessment. ECS, extracellular solids; ECF, extracellular fluid; TBK, total body potassium; BIA, bioelectrical impedence analysis; TSF, triceps skinfold thickness; AMC, arm muscle circumference; DEXA, dual-energy X-ray absorptiometry. (Adapted from Wang *et al*. 1992.)

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Table 2. Possible sources of error in skinfold measurements in obese individuals

Errors of skinfold measurement in obesity	Reference
Difficulty in landmark identification	Bray & Gray (1988)
Technical restrictions of caliper jaw width	Gray *et al.* (1990)
Greater variation in skinfold compressibility (altered hydration state)	Clarys *et al.* (1987)
Inter-observer error of measurement higher	Bray & Gray (1988)

basis for the alterations in hydration status seen in obesity as well as the predictive power for co-morbidities often accompanying obesity, such as CHD (Haffner & Taegtmeyer, 2003).

Whilst the skinfold method is not a routine part of screening it is used in the assessment of undernutrition and obesity. However, it may be inaccurate in determining body fat in obese individuals because of the poor reliability of the measurement (see Table 2). In addition, the error associated with the use of standard regression equations to estimate body fat may introduce further error in the estimations (Heyward *et al*. 1992). This error is compounded by the changing relationship between total body fat and subcutaneous stores as fatness increases. Such errors may become clinically significant in the injured obese patient.

Nutritional assessment of the injured obese

Further alterations in hydration status will occur in response to injury, which may compound the already increased hydration state observed in obesity (Albu *et al*. 1989). This situation will lead to inaccurate determination of weight and any screening tool using steps involving calculations, such as BMI, that are based on weight. Furthermore, more complexity will be introduced into any determination of nutritional requirements that is based on body weight alone, since modifications of body weight do not precisely reflect a particular patient's nutritional status (Pichard *et al*. 2000). In addition, the variable utilisation of fat and lean tissue to cover metabolic demands during illness and recovery need to be accounted for in order to prevent protein malnutrition. With already altered body composition in obesity reflected as an increase in cell mass (fat mass and fat-free mass) and bone as well as total body water, the addition of a metabolic response in injury or trauma makes the evaluation of nutritional goals more difficult. With accelerated mobilisation of more protein and less fat (Ireton-Jones & Francis, 1995) in obese patients with trauma than in non-obese patients, precise calculation of nutrient requirements, taking into account the magnitude of the metabolic response, are required to limit N losses.

At a practical level such calculations are based on actual body weight or ideal body weight. In injured obese patients where weighing may not be possible the use of recalled weight may be indicated as a reliable substitute. However, there is evidence to suggest that obese individuals will underestimate their weight on recall (Roberts, 1995), which will in turn introduce error into estimating requirements as well as percentage weight loss calculations, and BMI estimations.

Obesity alone is associated with increased morbidity and mortality, and overweight individuals have a higher risk of cardiovascular and respiratory diseases. In the injured obese patient nutritional support (Ireton-Jones & Francis, 1995), wound healing and respiratory problems have been identified as areas posing specific challenges to the care of these patients (Hahler, 2002). These problems can lead to increased hospital stay as well as post-operative complications (Fasol *et al*. 1992), which may be associated with increased body weight and adiposity *per se* (Blackmer & Marshall, 1997). However, the role of concomitant metabolic disturbances that accompany obesity and the increased inflammatory mediators and decreased endogenous anti-inflammatory mediators reported (Engeli *et al*. 2003) in this population may be pivotal in the recovery and rehabilitation of such patients. Obese individuals may be excluded from screening or not identified as at risk through the process of screening, but they have increased morbidity and possibly mortality. An effective screening method to identify the obese injured patient at risk should be found to improve physical function, reduce the severity of complications, accelerate recovery from disease or injury and reduce consumption of resources, the four key outcomes identified as the purpose of nutritional screening (Kondrup *et al*. 2003).

Conclusion

Published data relating to the validity of nutritional screening tools need to be interpreted within the overall aim of the screening process. Screening for undernutrition will identify undernourished individuals, but does one size fit all? A case clearly exists for the necessity of early identification and intervention in undernutrition. However, with the increasingly obese population likely to be screened and perhaps excluded, along with evidence accumulating for increased morbidity in the injured obese patient, is the nutritional care of these patients as clear cut as that of their undernourished counterparts?

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