Annals of the Royal College of Surgeons of England (1987) *vol.* 69

Malnutrition and surgical risk: guidelines for nutritional therapy*

GRAHAM L HILL FRCS
Professor of Surgery,
University of Auckland

Key words: SURGICAL MALNUTRITION; NUTRITION; PERIOPERATIVE; RISK FACTORS IN SURGERY; INTRAVENOUS; ENTERAL; CLINICAL

Introduction

In the mid 1930's a Cleveland Surgeon, Hiram Studley, looked carefully at number of factors which he felt may contribute to the high mortality after gastrectomy for peptic ulcer disease *(1)*. Carefully, controlling for the age of the patient, the operating surgeon and the type and length of the procedure, he found a striking correlation between the magnitude of preoperative weight loss and postoperative mortality. Now, fifty years later, his study is still cited by those seeking proof that protein energy malnutrition when present preoperatively, is a risk factor for postoperative complications. In Studley's patients, the cause of most of the deaths which occurred, was respiratory infection and this was associated in some patients with wound dehiscence. Today, however, with prophylactic antibiotics, better anaesthetic and fluid balance techniques, improved suture materials and vigorous physiotherapy, there are inbuilt safeguards to minimise such complications and it is reasonable to ask if malnutrition is a risk factor at all in modern surgical practice. Indeed, experienced surgeons know full well that some very thin patients recover remarkably quickly, even after very major surgery, and some feel that this is clear evidence that depleted body stores fat and protein do not influence postoperative outcome. Others, however, point out that some modern prospective studies appear to show that severely malnourished patients are still at increased risk of developing complications after major surgery and that preoperative nutritional repletion lessens this risk *(2,3)*.

In these times of escalating costs, it would be of value to show clear evidence that expensive inhospital nutritional repletion is of real benefit to patients awaiting major surgery. As yet, however, information is not complete and more evidence is required before substantive changes in clinical practice should be made. Here, some of the available evidence will be examined, and new work relating to it will be described, before setting out some practical guidelines which may be useful for patient management at the present time.

* Based on a Hunterian Lecture delivered at The Royal College of Surgeons on 27th March 1986.

Correspondence to: Graham L Hill, Professor of Surgery, University Department of Surgery, Auckland Hospital, Park Road, Auckland, New Zealand.

Effects of malnutrition on body composition and function

There are now available, data which suggest that, among other abnormalities, there are abnormalities of body composition, skeletal muscle function and respiratory function in malnourished surgical patients awaiting major surgery. There also appears to be an impairment in the wound healing response, and, although data concerning immune function are less clear, there are probably immunological deficiencies as well.

Body composition studies These have shown that, cellular protein, particularly that of skeletal muscle, is wasted. It is currently believed that the structural proteins, (tendon, bone etc.) are not wasted in most malnourished patients. In most patients, as the body loses weight, extra cellular fluid accumulates and this occurs *pari pasu* with a loss of cellular protein *(4)*. Thus, a malnourished patient who is losing weight may be said to have a 'shrinking body cell mass surrounded by a growing sea of extracellular fluid'. The clinical application of these findings is that malnourished surgical patients are usually intolerant of excessive loads of salt and water. There is a tendency towards hyponatraemia, hypotonicity and oedema.

Skeletal muscle function Studies have shown that muscle strength is decreased, fatiguability is increased, and there are deficits of muscle fibre types and enzymes, which may account for these functional changes *(5,6)*.

Respiratory function This also has been shown to be affected in malnourished subjects who have a reduced capacity to sustain adequate levels of ventilation from effects on both the central nervous system and respiratory muscles. Neural ventilatory drive is impaired and inspiratory and expiratory muscular weakness is demonstrable *(7)*.

Wound healing response Although there is ample evidence that protein deficiency is associated with impaired wound healing in animals, it has been much more difficult to obtain objective data, which suggests the same holds true for adult surgical patients *(8)*. Very recently, the wound healing response in malnourished surgical patients has been assessed by a microimplant technique. The response appears to be impaired in such patients, although the effect is seen at a much earlier stage than had previously been supposed *(9)*. It is probably more related to deficiencies in dietary intake than to absolute amounts of body protein that have been lost.

Immune function As far as this is concerned, the data are less clear. Nevertheless, the concensus of many studies shows that protein energy malnutrition is commonly associated with an acquired immune deficiency *(10)*. Of the two recognised, extreme variants of protein energy malnutrition, protein deficiency is characterised by an impairment in protein synthesis, manifest by a depression of serum albumin levels and relatively severe immune deficiencies. Where both protein and energy deficits occur, the serum albumin levels are better maintained, and immune function appears to be less severely effected.

If surgical malnutrition has such wide spread biological manifestations, what is the evidence that protein deficiency leads to an increased risk of major complications? A very recent study of 83 patients awaiting gastrointestinal resections suggests that there is a relationship between preoperative deficits in body protein stores and the outcome of the surgical procedure *(11)*. Forty eight of the patients had considerable losses of body protein (average 37%) and their outcome after a major gastrointestinal resection was more complicated than the 35 patients in whom the average protein loss was only 3%. Major complications, most of which were pneumonia, were increased more than four times, sepsis was twice as common and hospital stay was increased in the group with protein deficiency by five days.

Effects of nutritional repletion on body composition and function

While the evidence presented here all seems to suggest that malnourished surgical patients awaiting major surgery, have abnormalities of body composition and function of a type which may predispose him/her to an increased risk of respiratory and wound healing problems, sepsis and prolonged hospital stay, it is much more difficult to find convincing evidence that nutritional repletion returns these abnormalities to normal, and reduces the risk of postoperative complications. There are, however, data which show that a two-week course of intravenous nutrition can increase body stores of protein, although this only occurs in depleted patients in whom there is no evidence of sepsis *(12)*. Intravenous nutrition has also been shown to reverse abnormalities of muscle fibre types and enzyme deficiencies *(6)* and increase the oxidation of administered glucose solutions *(13)*. Although there are some data to suggest that preoperative nutrition enhances the wound healing response *(14)*, it has not been clearly demonstrated that a short course of intravenous nutrition improves skeletal muscle function, respiratory muscle function or the immune response. These dissappointing objective data appear to be in stark contrast to the common clinical observation that some patients with severe malnutrition, look and feel better, begin to respond to their infective process and start to heal their wounds within a week or two of beginning nutritional therapy. Clearly, much more work needs to be done at a basic level, before it will be known if the efects of a week or two of intravenous nutrition alter the biology of the malnourished surgical patient in a clinically significant way.

Evidence that intravenous nutrition, given over a one to two-week period before surgery, reverses the tendency to increased postoperative complications is not yet available. Two major prospective studies currently being conducted in the United States are awaited with considerable interest, but prospective studies of preoperative nutritional therapy that have already been completed, have not directly answered the question *(3,15,16)*. The most important of these studies, is that of Muller's from Cologne, where preoperative nutrition was given on a randomly assigned basis to all patients undergoing surgery for gastrointestinal cancer, regardless of nutritional state *(3)*. It is of interest, that in the group who received preoperative nutritional therapy, a reduction in both postoperative complications and mortality was noted.

Selection of patients at risk

The selection of patients for preoperative nutritional therapy is the subject of considerable research. It is claimed that indices of nutritional state can identify subsets of patients at high risk of postoperative complications and that these indices are useful tools for the selection of candidates for preoperative nutritional support. Profound weight loss, some anthropometric indices, tests of muscle function, plasma proteins including albumin, transferrin and prealbumin, and combinations of these (which are usually called prognostic nutritional indices), have all been used as indicators of risk of postoperative nutrition associated complications. They are said, by those who use them, to indicate the need for nutritional repletion prior to the operation itself. A formal comparison of these indicators of risk, was recently made *(17)*, and this showed that the measurements of weight loss and a variety of anthropomorphic indices were not clear indicators of risk, but measurements of grip strength and low levels of plasma proteins, were to some extent, indicators of risk of postoperative complications. The various prognostic indices, which are largely determined by plasma protein levels, had little more to offer. Thus, the indices of hepatic and muscle function were more helpful in identifying patients at risk of nutrition associated complications. It seems reasonable, therefore, to conclude that patients particularly at high risk should be able to be picked out by thorough physical examination and nutritional assessment, findings of which are then related to abnormalities in specific organ systems. In the same study it was also found that a thorough clinical examination, which assessed major organ function, proved to be as effective as any other indicator in identifying at risk subjects *(17)*. A recent prospective study of 101 patients awaiting major abdominal surgery demonstrated that those patients with more than 10% weight loss, which was associated with clinical evidence of physiologic impairment of vital bodily functions, had an increased postoperative complication rate and a prolonged hospital stay *(18)*. For clinical purposes then, a fairly adequate assessment of malnutrition and its associated risks, can be obtained from a good history of dietary intake and energy output and a careful physical examination to assess the effect of weight loss on each of the main organ systems. Plasma albumin should also be measured. As a general guideline, body weight loss of 10%–15% or more below well weight, accompanied by clinical evidence of muscle weakness (respiratory and limb) and impaired physical endurance, should alert the clinician to the possibility of increased risk of nutrition associated complications. If the plasma albumin level is less than 32 grams per litre, it is likely that sepsis is present, or has been in the recent past, and postoperative septic complications and impaired wound healing are a possibility. In the recent study from Auckland, of 101 patients awaiting a major gastrointestinal resection, 43% of the patients had malnutrition to this degree *(18)*, but since this represented a group of patients referred to a tertiary care teaching hospital, it should be stressed that this in no way represents the proportion of patients presenting for routine elective surgery who may require treatment. In reality that has been assessed as probably less than 5% *(2)*.

Clinical guidelines

Based on the evidence set out above, tenuous though it may be, it is this author's present view that some malnourished patients at risk may benefit from a period of nutritional repletion before embarking on a very major procedure. Here are some general guidelines for the practising surgeon which are currently being used at the University of Auckland. Although very sophisticated algorithms have been suggested for selecting patients for preoperative nutrition *(19)*, in clinical practice the process can be made more straightforward (Fig. 1). There are three factors which must be considered when a patient is presented as a possible candidate for preoperative nutritional support: his or her nutritional state with its associated functional impairment, the magnitude of the projected operative procedure and the anticipated response to the nutritional therapy. The use of the scheme shown in Fig. 1 will enable the practising surgeon to more easily select patients who may benefit from a two-week course of intravenous nutrition.

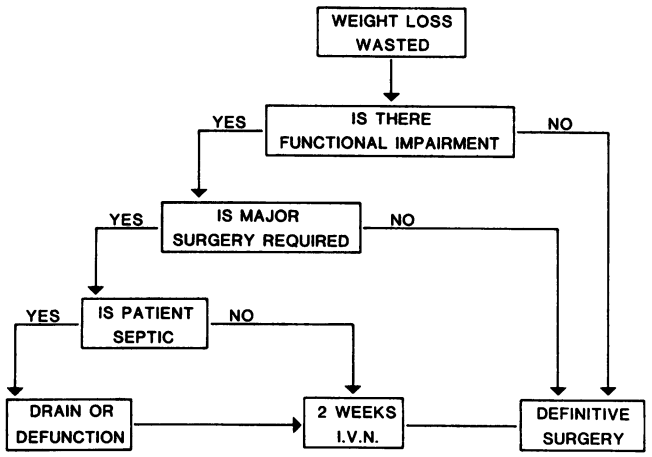

FIG. 1 Simplified algorithm used at the University of Auckland for selecting patients for preoperative nutrition. Weight loss and other clinical evidence of malnutrition is not important unless there is evidence of muscle weakness (respiratory and limb), impaired physical endurance and a low level of plasma albumin. If the planned operative procedure is a major one, that is one which is usually associated with a complication rate of around 20%, then a two-week course of intravenous nutrition may be indicated, providing the patient is non-septic. Sepsis must first be controlled before repletion can properly occur.

References

1 Studley HO. Percentage of weight loss. A basic indicator of surgical risk in patients with chronic peptic ulcer. JAMA 1936;106:458–60.

2 Warnold I, Lundholm K. Clinical significance of preoperative nutritional status in 215 non-cancer patients. Ann Surg 1984;199:299–305.

3 Muller JM, Brenner U, Dienst C, et al. Preoperative parenteral feeding in patients with gastrointestineal carninoma. Lancet 1982;1:68–71.

4 Beddoe AH, Streat SJ, Hill GL. The hydration of the fat-free body in protein depleted patients. Am J Physiol 1986; 249 (Endocrinol Metab 12): E227–33.

5 Russell DM, Jeejeebhoy KN. The assessment of the functional consequences of malnutrition. Nutr Abs Rev Ser A: Human and Exper 1983;53:863–77.

6 Church JM, Choong SY, Hill GL. Abnormalities of muscle metabolism and histology in malnourished patients awaiting surgery; effects of a course of intravenous nutrition. Br J Surg 1984;71:563–9.

7 Rochester DF, Esau SA. Malnutrition and the respiratory system. Chest 1984;85:411–15.

8 Lindstedt E, Sandblom P. Wound healing in man: tensile strength of healing wounds in some patient groups. Ann Surg 1975;181:842–6.

9 Haydock DA, Hill GL. Impaired wound healing in surgical patients with varying degrees of malnutrition. JPEN 1986;10:550–4.

10 Superina R, Meakins JL. Delayed hypersensitivity, anergy and the surgical patient. J Surg Res 1984;37:151–74.

11 Windsor JA, Hill GL. Depleted protein stores lead to an increased complication rate after major surgery. Aust NZ J Surg 1987;57:259.

12 Witney GB, Streat SJ, Hill GL. Classification of surgical malnutrition—a new approach of clinical relevance. Aust NZ J Surg 1987;57:260.

13 Church JM, Hill GL. Impaired glucose metabolism in surgical patients improved by intravenous nutrition—Assessment by the euglycemic hyperinsulinemic clamp. Metabolism 1987 (In Press).

14 Haydock DA, Hill GL. Improved wound healing response in surgical patients receiving intravenous nutrition. Br J Surg 1987;74:320–3.

15 Heatley RV, Lewis MH, Williams RHP *et al.* Preoperative intravenous feeding—a controlled study. Postgrad Med J 1979;55:541–5.

16 Holter AR, Fischer JE. The effects of perioperative hyperalminentation on complications in patients with carcinoma and weight loss. J Surg Res 1977;23:31–4.

17 Pettigrew RA, Hill GL. Indicators of surgical risk and clinical judgement. Br J Surg 1986;73:47–51.

18 Windsor JA, Hill GL. The clinical assessment of physiological functions: An important advance in the nutritional assessment of surgical patients. Aust NZ J Surg 1987;57:256.

19 Detsky AS. Mendelson RA, Baker JP, *et al.* The choice to treat all, some or no patients undergoing gastrointestinal surgery with nutritional suport: a decision analysis approach. JPEN 1984;8:245–53.

Received 9 April 1987