Enteral and Parenteral Nutrition

A CLINICAL HANDBOOK

EDITED BY

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Preface

The recognition that nutritional neglect can occur in modern hospital practice led recently to the establishment of a 'nutrition team' in several centres. The formation of the Oxford team has enabled an evaluation and improvement of feeding techniques to be carried out and has developed an invaluable co-operation between doctor, nurse, pharmacist, dietitian and biochemist.

In this book we apply a broad approach to the nutritional therapy of the vulnerable patient--whether it be extra slices of bread and butter, or total parenteral nutrition.

We wish to promote an increased awareness of the nutritional care of all patients and encourage the reader to view parenteral nutrition within the full range of feeding possibilities.

We would like to thank the many people who have supported our efforts and especially the secretarial help of Clare Flanagan, Madeline Carvell, Joanna Eadle and Doreen Hagar.

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Andrew Grant
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Chapter 1 · Meeting Patients Needs

The close association between malnutrition and morbidity and even mortality has been known for a long time. Recent surveys have drawn attention to unacceptable malnutrition in British (Hill *et al,* 1977) and American hospitals (Bistrian *et al,* 1974). Not only is malnutrition quite common but it is more prevalent in surgical wards, and is more severe with increasing hospital stay.

Parenteral nutrition has become a popular but probably misused treatment. It is therefore very important for clinicians and nurses to recognise those patients who should receive special nutritional support and to be able to decide rationally what form this support should take.

The clinician, dietitian or nurse needs to assess carefully the diet of any patient likely to need support, and to repeat the exercise regularly. This is in essence a return to the values of Florence Nightingale (1859) who wrote, 'Every careful observer of the sick will agree in this, that thousands of patients are annually starved in the midst of plenty, for want of attention to the ways which alone make it possible for them to take food . . . I would say to the nurse have a rule of thought about your patient's diet. Consider. Remember how much he has had and how much he ought to have today'.

Effective nutritional support can be given in several different ways. Table 1.1, p. 2, illustrates the range of support, from simple to complex. For example the appropriate means to meet the nutritional needs of an elderly patient who cannot take meals normally may simply be additional nursing care to ensure that meals are appetising, and contain sufficient protein, calories and other nutrients. The other end of the spectrum is the patient requiring large amounts of intravenous protein and calories because of major injury.

It is the purpose of this chapter to fit the nutritional support to

Table 1.1. Examples to illustrate the range of nutritional support.

Methods requiring patient co-operation
Nursing support
Encouragement and help with feeding
Ensure food is eaten
Anticipation of patient's needs
Diet modification—consultation with dietitian
Special needs e.g. high calorie
Altered consistency—semi solid or liquid
Methods less dependent on active patient co-operation
Tube feeding
Nasoenteric tubes
Feeding gastrostomy
Feeding jejunostomy
If the function of the gastrointestinal tract is impaired or inadequate
Intravenous feeding
Intravenous feeding combined with enteral feeding
Peripheral vein feeding
Central vein feeding

the individual patient. It is not easy to classify those conditions that most often require additional nutritional support. Table 1.2 gives a basic classification but clearly the support required depends on the individual patient and the extent of his disease. Assessment of the patient involves a consideration of:

1 dietary history,
2 present nutritional status,
3 an estimate of present and predicted needs.

DIETARY HISTORY

The dietary assessment should be considered in two parts and *recorded.* Firstly an estimate is made of the food intake over the past few weeks by careful questioning about meal patterns, types and quantities of food normally eaten throughout the day; whether snacks or sweets are eaten between meals; whether the appetite has changed recently and whether meals are eaten in

Table 1.2. Examples of conditions that may require additional nutritional support.

Depressed appetite
Cancer patients—especially during chemotherapy or radiotherapy
Anorexic patients
Some chronic conditions e.g.
renal disease
chronic heart disease
Inability to feed
Old people living alone
Disorientation
Strokes
Coma
Gastrointestinal failure
Oesophageal obstruction e.g. stricture or cancer
Malabsorption e.g. Crohn's disease; radiation enteritis
Chronic liver disease
Pancreatitis
Protein losing enteropathy
Increased needs
Severe burns
Septicaemia
Major trauma
Excessive loss from fistulae and drains

company (Beal, 1967).

This form of questioning will place the majority of patients into low, normal or high food intake groups (Black, 1981) and so allow a reasonable judgement about the influence of diet upon a patient's current clinical state.

Secondly an estimate should be made of a patient's intake in hospital. This allows early recognition of patients who need additional nutritional support and what form it should take. Protein and calorie values of common foods are given in the appendix p. 166.

ASSESSMENT OF NUTRITIONAL STATUS

The patient's nutritional needs are in part governed by the loss of reserves at the time of presentation. Numerous means of assessing body deficit have been described and are used to guide people in the nutritional care of patients, but no clear advantage has been

shown for using any of the more simple quantitative measurements or even several different ones together.

Probably the most important assessment is the clinical impression based upon the patient's history, his disease, and their effect upon body weight. This is an impression supported by such things as the feel of the subcutaneous tissues, the power in the limbs and the condition of the hair. In the hands of a sensitive clinician the sum of these features is probably far more subtle and accurate than dependence upon numeric values for several tests whose value is doubtful (Collins *et al,* 1979; Forse & Shizgal, 1980; Michel *et al,* 1981). However it is necessary to discuss some of the measurements more commonly used.

Body weight

Loss of weight is mainly made up of lost muscle, fat and fluid. Theoretically it is important to know which body compartment has suffered most because loss of lean body mass is associated with an increased wound infection rate (Cruse & Foord, 1973), poor wound healing (Irvin & Hunt, 1974) and possibly pulmonary complications because of reduced ventilatory capacity (Dockel *et al,* 1976). Injury and illness is usually accompanied by a loss of lean body mass. On the other hand loss of fat is of little significance in most Western people.

Actual body weight can be compared either to the ideal body weight for height, age and sex (tabulated in the appendix, p. 144), or to the patient's usual or remembered body weight, and expressed as a percentage weight loss. Loss of about 10% of body weight represents mild malnutrition, moderate malnutrition 20% weight loss and severe malnutrition greater than 30% weight loss.

Peripheral oedema or dehydration lead to misinterpretation of the observed weight loss. Again weight loss estimated from ideal body weight in obese patients can hide significant malnutrition. These caveats serve to emphasise the need to use common sense in the interpretation of weight loss. In addition the more rapid the weight loss the more severe the malnutrition is likely to be and greater is the risk to the patient.

Anthropometric measurements

Simple measurements to assess lean body mass and fat have been described. They have proved useful in field surveys of malnutrition (Jelliffe, 1966) but have not had satisfactory validation in hospital patients. The potential for observer error is great.

Skinfold thickness

Measurements of the skinfold thickness over the triceps, biceps, scapula and superior iliac crests using calipers gives an estimate of the body's subcutaneous fat reserve (Durnin & Rahaman, 1967).

Triceps skinfold thickness alone has also been used to estimate fat reserve and nomograms are available (Frisancho, 1974).

Mid-arm circumference

Arm circumference (AC) and triceps skinfold thickness (TST) allows arm muscle circumference (AMC) to be calculated.

$$AMC = AC - \pi TST$$

Percentile charts have been derived to be used as an index of malnutrition (Frisancho, 1974; Gurney & Jelliffe, 1973).

Muscle function

Muscle function is an important index of muscle mass and its integrity. Tests of respiratory function such as forced inspiratory and expiratory pressure as well as FEV (forced expiratory volume) and FIV (forced inspiratory volume) have been suggested as indices of respiratory muscle function. Tables of normal values are available (Black & Hyatt, 1969) and it has been suggested that malnourished patients have reduced pulmonary function which returns to normal with nutritional support (Grant, 1980). However normal pulmonary compliance and air-way resistance are implicit in these measurements which is frequently not the case in sick people.

Hand dynomometry is another measure of muscle function which has been suggested as a useful index of malnutrition (Klidjian *et al,* 1980) but once more sufficient data are not available.

Radioisotope methods

Total body nitrogen (Hill *et al,* 1978) or total body potassium (Boddy *et al,* 1972) are much more accurate methods of indicating lean body mass but both methods require expensive apparatus.

Laboratory measurements

Malnutrition affects all tissues. Most laboratory investigations reflect different influences and require considerable interpretation. The ideal of a single test of malnutrition is therefore impossible to achieve but plasma proteins have proved to be of greatest value.

Plasma proteins

Most plasma proteins, other than immuno-globulins are synthesised by the liver and have a varied response to malnutrition. Plasma albumin is commonly used as a marker of malnutrition and indeed low plasma levels often reflect malnutrition. Changes in plasma albumin levels however can be due to changes in circulating volume which accounts for most of the fall in plasma albumin commonly seen post-operatively. Furthermore, albumin's long half-life of 20 days makes it an insensitive barometer of malnutrition. Serum prealbumin, and retinol binding protein, with much shorter half-lives, are more sensitive indicators of malnutrition (Shetty *et al* 1979; Young & Hill, 1981).

Other laboratory tests

Anaemia is a common concomitant of malnutrition. Changes in a variety of measurements of immune status have been used to assess malnutrition and these are described in Chapter 9. Severe

malnutrition is also associated with disordered liver function tests, but these tests are not diagnostic of malnutrition. Mineral and vitamin deficiencies may also require investigation.

ASSESSMENT OF NUTRITIONAL REQUIREMENTS

Having established from the history and examination that a patient needs nutritional support it is necessary to decide what to give and how best to give it. Tables 1.3, 1.4 and 1.5 illustrate the framework for nutritional support though clearly the nitrogen and energy sources used depend on the route of administration.

Choice of route

It needs re-emphasising that if a patient can be fed naturally then this is the method of choice but if insufficient food is consumed then an alternative route is required. The failure to provide nutritious meals in an attractive manner is regrettably common in modern hospital practise. The development of a trayed meal service administered by auxiliary staff means that nurses relinquish their duty of caring for the patient's nutrition. Catering managers should be made more aware of the needs of patients and dietitians and nurses should be more concerned with the nutrition of general patients. For many undernourished or anorexic patients the prescription of small, frequent, nutritious meals is all that is required.

Liquid feed

Patients who find chewing and swallowing difficult or cannot take enough in the form of solid food can be managed successfully using liquidised food or proprietary liquid meals to supplement their diet.

Tube feeding

Patients who have a functioning gastrointestinal tract but lack the motivation or capacity to swallow food, can be fed by tube which

provides an excellent means of instilling a complete liquid diet. There are now many preparations which can be used and the development of a fine-bore flexible naso-gastric tube has considerably improved patient comfort and reduced reflux oesophagitis. A longer tube may be placed directly into the duodenum because duodenal and jejunal activity often recovers before the stomach. Fine-bore silastic tube feeding can also be used successfully at home (Allison, 1981).

Tube gastrostomy and jejunostomy

Gastrostomy and jejunostomy tubes inserted at operation are an important, and much underused means of feeding patients particularly after major upper intestinal surgery, for example oeseophagectomy and gastrectomy. Conventional balloon urinary catheters (12 or 14 FG) or fine-bore silastic tubes appear equally effective means of access. However an operation specifically for the purpose of inserting a feeding tube has been superseded by satisfactory parenteral nutrition.

INTRAVENOUS FEEDING

Parenteral nutrition is invasive, unphysiological and expensive. It is hardly surprising therefore that the literature abounds with the problems caused by this form of nutrition but careful attention to detail and parenteral nutrition teams minimise these problems (Fischer, 1980). This reminder serves to emphasise that parenteral nutrition should be reserved for those patients where there is no acceptable alternative and in those units where the necessary experience is available. Our preference is to use an infraclavicular subclavian vein access which allows a flexible prescription of hypertonic nutrients delivered from a 3 litre bag.

Others have suggested that satisfactory total parenteral nutrition can be achieved by peripheral veins (Grotte *et al*, 1980; Jeejeehboy & Close, 1981). Intravenous isotonic amino acids administered through peripheral veins has also been shown to reduce the post-operative negative nitrogen balance compared to

the conventional glucose electrolyte solutions. It has also been suggested that routine use of such amino acid solutions might delay or reduce the need for other nutritional support (Blackburn *et al*, 1980) but this is by no means proven and at present should not be used until further evidence is available and isotonic amino acid solutions become less expensive.

Parenteral feeding using a central line can also be successfully carried out at home for those patients who require long-term or permanent parenteral feeding (Scribner & Cole, 1979; Irving, 1981). These patients can lead a virtually normal life, connecting themselves to the intravenous feeding system at night. Success requires a well-trained patient and expert hospital support.

Cyclical feeding

It has been suggested that periodic rather than continuous feeding more closely resembles the physiological pattern of normal meals (Page & Clibon, 1980). Theoretically this allows the normal hormonal changes associated with a meal and the rest between meals to take place. Further work is required to verify this hypothesis.

CHOICE OF NUTRIENTS

A few important principles govern the choice of nutrients.

1 The patient's calorie, protein, mineral and vitamin requirements are determined primarily by the patient's metabolic state and not by the method of delivery. For example, a severely burned patient who is hypermetabolic will need so much protein and calories whether they are given orally, by tube, intravenously or any combination of these methods.

2 The nutritional regime should be as simple, safe and economic as possible.

3 Intravenous nutrition should mimic as far as practical normal nutrition.

4 Adjustments are commonly necessary as a result of monitoring the patient's progress.

Nitrogen and calorie requirements

The nitrogen and calorie requirements are closely intertwined and they generally increase with increasing energy expenditure or metabolic rate. In turn the metabolic rate increases with increasing severity of injury or illness (Elwyn, 1980). An approximate estimate of nitrogen and calorie requirements for individual patients can be made from Table 1.3 based on patient's body weight with an appropriate increment for increasing metabolic rate. The advantage of this method is that the prescription is individually prescribed and theoretically suited to each patient.

We have found however that most patients can be fed satisfactorily using standard regimes with careful monitoring. Individual prescriptions are reserved for the few patients who are metabolically unstable, for example those with severe sepsis, multiple injuries or liver or renal failure.

A more precise estimate of metabolic rate is made by measuring oxygen consumption (Bartlett *et al*, 1977). This technique is valuable in patients who are clinically hypermetabolic and the method is now available in many intensive care units particularly on patients who are ventilated mechanically. An estimation of nitrogen need is made by measuring urinary urea excretion or urine total nitrogen excretion. Allowances have, of course, to be made for changes in blood urea and also nitrogen losses from wounds and the gastro-intestinal tract (p. 92). The calculated nitrogen need also gives a guide to the patient's energy requirements (Table 1.3).

Close monitoring should ensure that each patient's requirements are met. Both calorie and protein adjustments may be needed to maintain a positive nitrogen balance.

Calorie source

There are few difficulties supplying sufficient calories into the intestinal tract but the best calorie formulation for intravenous nutrition is controversial. There is now however general agreement that glucose is the best intravenous carbohydrate and there are no real advantages in using fructose or sorbitol. Fat