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Diagnosis and treatment of malnutrition

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Despite the demonstration in the 1970s of malnutrition in medical and surgical patients, it remains as high today, with a reported incidence of up to 40%[1]. Most of these patients are not referred for dietary assessment or nutritional support, and by the time of their discharge from a hospital, a weight loss of around 5.4% has occurred[1]. Indications for nutritional support depend in part on the underlying disease process, the anticipated clinical benefit and the natural history of disease. Malnutrition can be difficult to diagnose, and has many causes and manifestations. Failure to recognise the importance of nutrition, and its possible beneficial effect on the patient's morbidity and speed of recovery, remains a problem.

Why does disease related malnutrition develop?

Malnutrition occurs when the patient's metabolic requirements exceed nutrient intake; it can thus result from reduced nutrient intake, increased nutritional requirement or inability to absorb or utilise nutrients. In diseases such as Crohn's disease and cystic fibrosis, all these factors may coexist. There are several reasons for reduced nutritional intake. Disease states that may benefit from nutritional support are listed in Table 1.

Clinical consequences of malnutrition

The most common nutritional deficiency in hospitalised patients is protein-energy malnutrition. This can develop rapidly with acute illness and over many months or years with chronic disease.

Total starvation in healthy adults for up to 2–3 days causes predominantly loss of glycogen and water, with minor functional consequences. More severe functional deficits develop with approximately two weeks of semi-starvation in healthy adults, and death occurs within 70 days of total starvation[2]. Starvation causes depression, anxiety, irritability, apathy, loss of muscle strength and physical capacity[3] which, in turn, can lead to loss of morale and of will to recover, and inability to concentrate. Cardiorespiratory dysfunction resulting from malnutrition increases risk of

Table 1. Disease states suitable for enteral nutritional support.

Disease state	
Anorexia	Pre- and post-radiotherapy and chemotherapy
Neurological or mechanical dysphagia	Trauma
Acutely ill elderly patients	Hepatic failure
Burns	Renal failure
Sepsis	Respiratory failure
Intensive care/coma	Entero-colonic fistulae
Pre- and post-operative	Inflammatory bowel disease
Stomatitis, oesophagitis (eg candida)	Gastroparesis

chest infection[4] and limits mobility, predisposing to thromboembolism and pressure sores. Wound healing in malnourished patients is impaired, with a higher incidence of post-operative infection compared to normally nourished patients[5]. For all these reasons, disease-related malnutrition may contribute to increased mortality, morbidity and length of stay in hospital.

Detecting disease-related malnutrition

Patients are currently ineffectively screened for nutritional status both on admission and during their stay in hospital[1]. The British Association of Parenteral and Enteral Nutrition (BAPEN) has made recommendations for simple nutritional screening that nursing and medical staff can carry out on inpatients[6,7]. BAPEN suggests:

- recording height and weight
- calculating body-mass index (BMI) (weight (kg)/height (m)^2): BMI <20 indicates malnutrition)
- asking patients simple questions about recent weight loss, their usual weight, and whether they have been eating less than usual.

This basic information gives an indication of which patients are malnourished or at risk of malnutrition. Such an assessment should be made on or shortly after admission to hospital so that early nutritional support can be instituted. Grading severity of malnourishment in one of three categories will indicate their requirement for enteral nutritional support[8] (Table 2).

Treatment of malnutrition

It is not always possible to get malnourished patients to eat more food, and artificial nutritional support may be required, with oral dietary supplements, enteral tube feeding, parenteral nutrition or a combination of methods. BAPEN recommends that provision of artificial nutritional support be supervised by a multi-disciplinary nutrition support team[9].

Table 2. Indications for enteral nutritional support (modified from Ref 8).

Severe malnutrition	Weight loss >10% Albumin <30 g/l Marked muscle wasting and oedema BMI <15
Moderate malnutrition	Inadequate nutritional intake for preceding 2–4 weeks Nutritional measurements suggestive of protein-calorie malnutrition BMI 15-19
Risk of malnutrition	Underlying medical or surgical condition may result in malnutrition if artificial nutritional support not given

BMI = body-mass index

Hospital food

The Health of the Nation report, *Nutritional guidelines for hospital catering,* recommends an energy intake of 1,800–2,200 kcal/day for hospitalised patients[10]. Despite adequate provision of food, actual intake is often inadequate, with a high wastage. Factors contributing to this wastage include unpalatability, inadequate assistance with eating and the patient not receiving the food ordered.

Artificial nutritional support

The average adult requirements for nutritional support are outlined in Table 3 (derived from Refs 11 and 12).

Enteral nutrition is cheaper, more physiological and has fewer complications than parenteral nutrition[11], and should in general be used for patients with a functioning bowel, provided that there are no contra-indications. These two methods of feeding are not mutually exclusive, and a combination of enteral and parenteral nutrition is sometimes useful. An estimation of energy requirements can be derived from Schofield's equation (Table 4)[11,13].

Factors to be considered before instituting artificial nutritional support include gastrointestinal function, risk of aspiration, expected duration of nutritional support, and route of access (parenteral or enteral)[11].

Oral dietary supplements

Oral dietary supplements improve the short-term outcome in patients undergoing elective moderate to major gastrointestinal surgery, reducing wound infection and adhesions[14]. Elderly patients with fractured neck

Table 3. Average adult nutritional requirements (modified from Refs 11 and 12).

	Nutritional requirements		
Metabolic state	**Normal**	**Intermediate**	**Hypermetabolic**
Protein (g/kg)	1	1.3–1.9	2–3
Nitrogen (g/kg)	0.17	0.2–0.3	0.3–0.45
Energy (kcal/kg)	25–30	30–35	35–50
Water (ml/kg)	30–35	30–35	30–35

Table 4. Guide to estimation of basal metabolic rate (BMR) and energy requirements (modified from Refs 11 and 13).

Women age (years)	Estimated BMR (kcal/day) W = weight in kg	Men age (years)	Estimated BMR (kcal/day) W = weight in kg
15–18	13.3W + 690	15–18	17.6W + 656
18–30	14.8W + 485	18–30	15.0W + 690
30–60	8.1W + 842	30–60	11.4W + 870
>60	9.0W + 656	>60	11.7W + 58

1. To the BMR add a combined factor for activity and diet-induced thermogenesis:
   - bed bound +10%
   - bedbound mobile/sitting +15–20%
   - mobile on ward +25%
2. To the BMR add a stress factor:
   - burns 5–70%
   - severe sepsis/multiple trauma 10–50%
   - surgery 10–30%
   - temperature 10% for each 1°C rise.
3. If increase in energy stores and weight is required, add 200–1,000 kcal/day.
   If a decrease in energy stores is required, reduce energy input.

of femur also benefit: given nutritional support, they develop fewer complications[15].

Nasogastric and nasoenteric tube feeding

Early nasogastric tube feeding benefits stroke patients and reduces the average length of stay in hospital from 30 to 20 days[16]. Patients with a pre-operative weight loss of more than 10% given enteral nutrition for 7–10 days pre-operatively had fewer complications than those not given such nutritional support[17].

Enterostomy feeding

There are several methods of feeding patients by enterostomy tube (Table 5). Percutaneous endoscopic gastrostomy (Figs 1, 2 and 3) and jejunostomy are becoming increasingly popular ways of providing long-term nutrition support, and when nasogastric tube feeding is not tolerated.

Parenteral nutrition

Parenteral nutritional support should be reserved for patients unable to absorb (or receive safely) adequate nutrition through the gastrointestinal tract as a result of surgery or disease. The peripheral venous route is suitable for many patients requiring short-term parenteral nutrition. The success of peripheral feeding has been improved, and the incidence of complications reduced, by the use of long fine-bore catheters[18,19], but these lines must be inserted and cared for using aseptic techniques to minimise

Table 5. Methods of tube feeding patients.

- Nasogastric tubes
- Nasoenteric tubes
- Percutaneous endoscopic gastrostomy
- Percutaneous endoscopic gastrojejunostomy
- Direct percutaneous endoscopic jejunostomy
- Fluoroscopically inserted percutaneous gastrostomy
- Surgical jejunostomy
- Laparoscopic gastrostomy
- Needle catheter jejunostomy
- Cervical pharyngostomy
- Oesophagostomy

Key Points

- Malnutrition is common in hospitalised patients
- Malnutrition prolongs hospital stay and increases morbidity and mortality
- Treating malnutrition reduces morbidity
- Nutritional support can be given as oral supplements, by nasoenteral or enterostomy tubes or by parenteral (peripheral or central) routes
- Assessment and treatment of malnourished patients and prevention of refeeding syndrome should ideally involve a nutrition team

the risk of phlebitis, infection and cannula blockage. Our approach is to add hydrocortisone (5 mg/l) and heparin (500 IU/l) to the peripheral feed to reduce the incidence of thrombophlebitis. There is some evidence that glyceryl trinitrate patches[20] and topical non-steroidal creams[21] may also reduce the incidence of thrombophlebitis if a short cannula (eg venflon) is used for peripheral nutrition. If the feed contains significant quantities of calcium (>5 mmol/l), heparin is probably best avoided because of the risk of developing calcium-heparin bridges with phospholipid, causing droplet formation[22].

Monitoring of artificial nutrition

General assessment

Patients receiving artificial nutritional support should be watched closely for signs of the refeeding syndrome[11] (see below). Diet charts help to record what the patient has received, rather than what was prescribed, as the two do not always agree.

Figure 1. Equipment required to insert a percutaneous endoscopic gastrostomy (PEG) tube by the 'pull technique'.

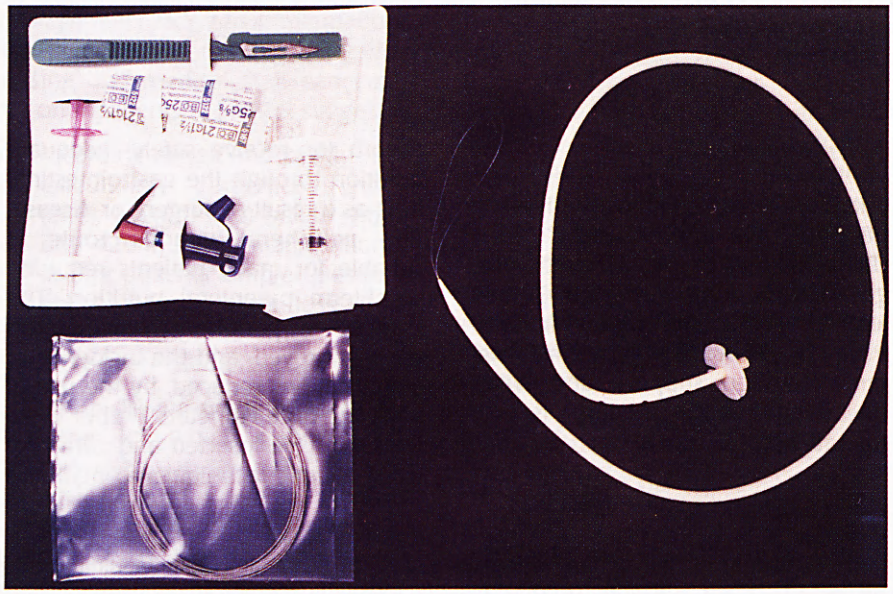
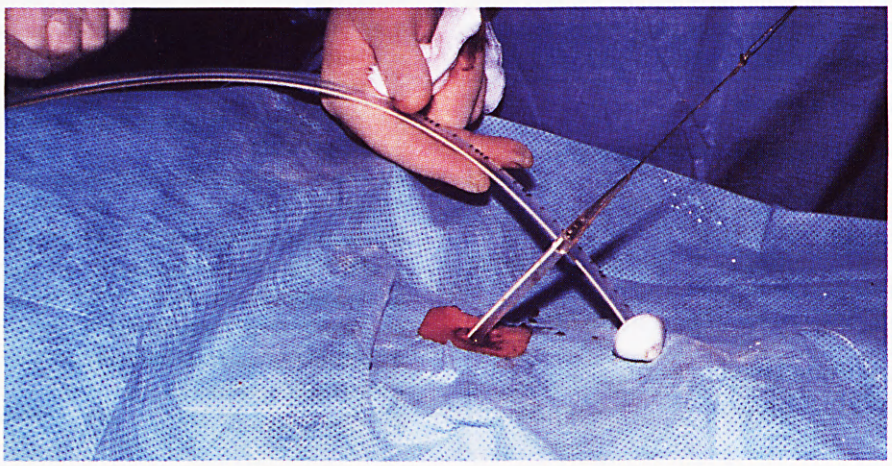


Figure 2. The PEG tube being drawn through the abdominal wall.



Weighing the patient and assessing muscle bulk, subcutaneous fat (triceps skinfold thickness), hand grip strength[11], and examining for oedema will give a guide to the general nutritional status. Serial measurements can be useful in assessing progress.

Haematological and biochemical assessment

Basic haematological and biochemical measurements should be made before introducing nutritional support. Initially, close monitoring of urea, creatinine, sodium, liver function, magnesium, calcium, potassium, phosphate and glucose is required[23]. If clinically indicated, patients on long-term enteral nutrition may need vitamin and trace element analysis. Albumin, transferrin and retinal binding protein are not reliable markers of nutritional status[11]. If abnormalities in liver function tests develop, a few hours' break each day from feeding often resolves the problem.

Refeeding syndrome

Refeeding malnourished patients increases basal metabolic rate, with glucose the predominant energy source[23]. This anabolic response causes intracellular movement of minerals, serum levels of which may fall significantly. These rapid changes in metabolism and electrolyte movement may lead to severe cardiorespiratory and neurological problems, resulting in cardiac and respiratory failure, oedema, lethargy, confusion, coma, convulsions and death[23].

Symptoms of the refeeding syndrome are thought to be due predominantly to hypophosphataemia, but hypokalaemia, hypomagnesaemia, hypocalcaemia and thiamine deficiency may also contribute. Intracellular fluid increases, and extracellular fluid may decrease or increase depending on the refeeding regimen and previous fluid intake[23].

Our standard policy on initiating refeeding is as follows:

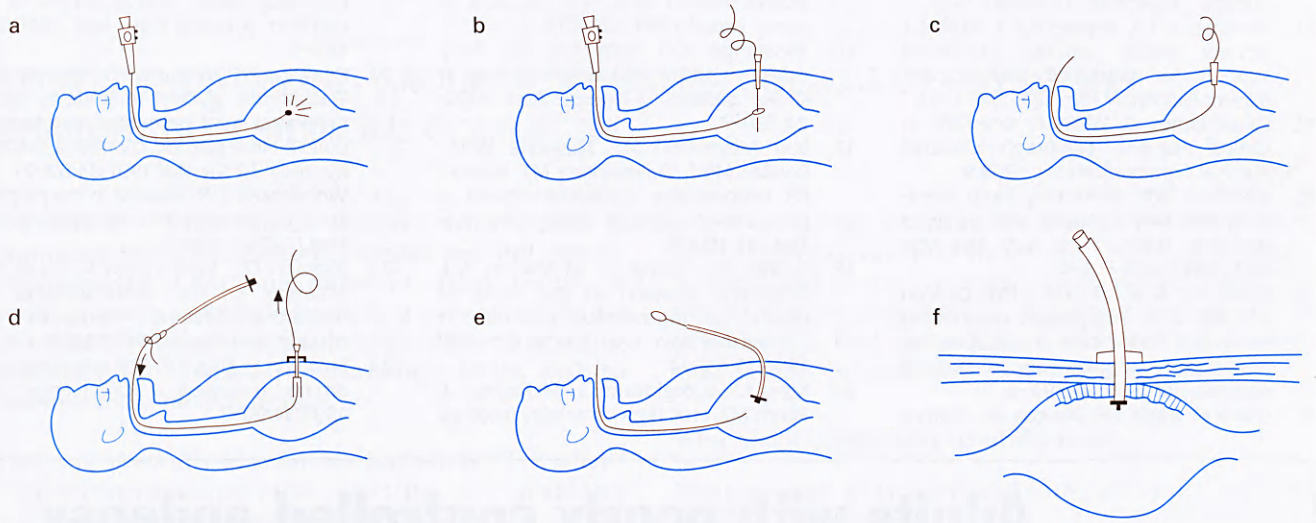


Figure 3. Technique of PEG insertion using the 'pull technique'. **(a)** The anterior abdominal wall is transilluminated by the endoscope light and the operator presses on the abdominal wall – the endoscopist can see the indentation and the operator sees the light. Local anaesthetic is inserted into the abdomen. **(b)** A trocar and cannula are inserted into the stomach by the operator, guided by the endoscope light. The trocar is removed and a wire passed through the cannula. The wire is snared. **(c)** The endoscope is removed, withdrawing the wire out through the mouth. **(d)** The PEG tube is tied to the wire. **(e)** The guidewire is pulled out through the abdominal wall, pulling the PEG tube down through the mouth into the stomach and then out through the anterior abdominal wall. **(f)** The PEG tube is cut to a suitable length and an external fixator device attached.

- measure urea and electrolytes daily
- monitor glucose (BM stix) frequently
- measure phosphate, magnesium, calcium and liver function tests twice weekly
- check haematology weekly
- keep daily records of weight and fluid balance.

The frequency of biochemical monitoring is adjusted according to the patient's clinical and metabolic status. Thiamine deficiency may be present in malnourished patients, so carbohydrate administration may precipitate Wernicke's encephalopathy. Patients at high risk from the refeeding syndrome are listed in Table 6.

Table 6. Patients at risk of refeeding syndrome.

- Chronic alcoholism
- Chronic malnutrition
- Prolonged fasting (especially if additional disease is present, eg pneumonia)
- Prolonged intravenous fluids for hydration
- Gross obesity with massive weight loss

Summary

Artificial nutritional support may be supplied by several routes. Its many potential complications can be avoided if they are anticipated and help sought early from the nutrition team.

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