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Assessing nutritional state in inflammatory bowel disease

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SUMMARY Nutrient depletion is a common complication of inflammatory bowel disease, and some of the consequences can be severe. Although it is often easy to recognise the most severely undernourished subjects, those with lesser degrees of malnutrition may prove more difficult to detect. Measurements of many nutritional variables will be abnormal in patients with inflammatory bowel disease, especially in those with Crohn's disease, but are not always relevant to the clinical management of patients. Anthropometric means of assessment, in particular, measurement of mid arm circumference, can act as a simple, reproducible method of detecting those most at risk of appreciable undernutrition.

In what was probably one of the earliest descriptions of Crohn's disease emaciation was apparently a striking clinical consequence.[1] Wasting and weight loss were also found to occur commonly in this disease in the original report by Crohn *et al* in 1932.[2] Although overt weight loss is one of the most striking features of active inflammatory bowel disease, many more nutritional disturbances also occur.[3]

Any patient with either ulcerative colitis or Crohn's disease can become severely wasted during an acute, unremitting attack of the disease. Chronic undernourishment, however, probably more commonly occurs in Crohn's disease than in ulcerative colitis.[4] Apparently well nourished subjects may become deficient in one or more nutrients but remain otherwise well. Undernourished subjects, on the other hand, are usually at risk of multiple deficiencies.[5]

The nutritional state of patients with inflammatory bowel disease is difficult to measure accurately and has, until recently, been only poorly documented. Traditionally, somewhat crude measures have been used, including overall clinical impression; changes in body weight; haemoglobin concentrations; and serum concentrations of folate, vitamin B_{12}, albumin, iron and total iron binding capacity.[6] Many complications of severe inflammatory bowel disease, especially poor wound and fistula healing, muscle wasting, depressed humoral and cellular immunity, and increased susceptibility to infection commonly occur in undernourished patients with other conditions. It is reasonable to assume that nutritional depletion is a major cause of these features in patients with inflammatory bowel disease, particularly as many can remit with nutritional treatment.[7] Some of these features of undernourishment are, in fact, useful variables by which to assess nutritional state in patients with inflammatory bowel disease.

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Anthropometry

Several large studies have documented weight loss in 70–80% of patients with Crohn's disease, and in some cases this was substantial.[8–10] These studies do not, however, take into account the weight of patients before illness, and weight loss in a thin person may be more important than a similar loss in an obese patient. Recently the emphasis has changed and concentrated on relating weight and anthropometric measurements of muscle and subcutaneous fat to ideal standards to determine how far patients vary from the norm. Harries *et al* studied an unselected group of consecutive outpatients with Crohn's disease who were attending a gastrointestinal clinic.[5] Many patients were considerably underweight and had significant reductions in muscle bulk and subcutaneous fat compared with a similar number of patients with ulcerative colitis and healthy subjects. About 20% of the patients with Crohn's disease were below 90% of their ideal weight, and particularly severely affected were

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males with diffuse small intestinal disease, especially that which recurred postoperatively, was currently active, and being treated with steroids. Lanfranchi *et al* found that 40% of 44 outpatients with Crohn's disease were below ideal weight, and they also reported similar reductions in anthropometric measurements.[11] Both of these studies were carried out in patients who were not acutely ill, and they emphasise that a considerable degree of undernutrition exists even in this type of patient. Patients with colonic disease were not particularly undernourished, in contrast to the patients studied by Dyer and Dawson,[12] a largely inpatient group with active disease. In the study by Harries *et al*[5] patients with ulcerative colitis had similar variables to healthy controls. None of these patients, however, had severe disease, and this probably explained their good state of nutrition, as in previous studies weight loss in ulcerative colitis was reported in 18 to 62% of patients.[13] Furthermore, over 90% of the group with ulcerative colitis did not smoke, a factor which can affect body weight.[14]

One simple and apparently readily applicable method of identifying those patients most at risk of undernutrition is the measurement of the mid arm circumference on the non-dominant upper limb. Mid arm circumference measurements correlate positively with body weight in patients with Crohn's disease. Furthermore, it has been shown that when these measurements are expressed as a percentage of ideal values, the 90% of ideal standard (giving an absolute measurement in adults of 26·4 cm in men and 25·7 cm in women) is a useful reference point in patients with Crohn's disease. In a large group of patients with Crohn's disease, of those with mid arm circumference measurements below these values, half were more than 10% below ideal body weight. These subjects were also at risk of many other consequences of nutritional depletion, having reduced serum albumin, prealbumin, ferritin, calcium and vitamin D concentrations, haemoglobin values, urine creatinine excretion, and peripheral blood lymphocyte numbers, including T cell counts.[5 15] Furthermore, the mid arm circumference measurements were highly reproducible, even in obese patients and, compared with other anthropometric criteria including skinfold thickness and mid arm muscle circumference, showed least intra-observer and interobserver variation.[16]

Linear growth is a useful means of assessment in childhood. Some impairment may occur in 15–30% of children with Crohn's disease.[17 18] O'Donoghue and Dawson found that stunted growth was the presenting feature in six of 33 children referred to hospital and was also the most common physical abnormality.[19]

Anaemia

Anaemia of varying severity can be found in 50–70% of patients who are receiving treatment predominantly in hospital.[8 20–22]

IRON DEFICIENCY

A low serum iron may be found in 50–70% of cases of Crohn's disease, usually in association with a low total iron binding capacity.[20 21 23] Bone marrow aspiration shows absent iron stores in 25–40% of patients, unrelated to the serum iron concentration.[24 25] The serum ferritin is believed to reflect reticuloendothelial storage iron and is closely correlated with the amount of stainable iron in the bone marrow.[26] Concentrations of less than 15 µg/l always indicate iron deficiency. In chronic inflammatory states, including inflammatory bowel disease, however, concentrations of 50 µg/l may be associated with true iron deficiency.[25 27]

Iron deficiency is the most important cause of anaemia in ulcerative colitis, usually through blood loss, and it tends to occur in patients with acute exacerbations.[28–30]

Using all of these tests, 25–50% of patients with Crohn's disease have iron deficiency.[24] In ulcerative colitis up to two thirds of patients can be affected.[31]

VITAMIN B_{12} DEFICIENCY

Diminished vitamin B_{12} absorption occurs in between one half and two thirds of patients with Crohn's disease and may be due to several different factors.[12 22 32–36] Deficiency is present, however, in only about one third of untreated patients with active disease.[20 21 23 24 32 35 37–39]

FOLIC ACID DEFICIENCY

Differing incidences of folate depletion reflect the clinical heterogeneity of Crohn's disease: two thirds of the patients studied by Hoffbrand *et al*[24] were ill, while the same proportion of the group investigated by Krause *et al*[20] had undergone surgical resection with no recurrence, and were presumably well. Elsborg and Larsen[38] found that 67% of patients with low serum and red cell folate concentrations had megaloblastic changes on bone marrow examination, often in the presence of normal haemoglobin concentrations. Overall, folic acid depletion probably occurs in about one third of patients with inflammatory bowel disease and active disease who are not receiving folate supplements.[21–23 32 35 38 39]

Albumin

Hypoproteinaemia has been recorded in various

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studies of Crohn's disease with an incidence of between 20–76%.[20 22 40 41] The most important cause of hypoproteinaemia is gastrointestinal protein loss,[42] but hypoproteinaemia and oedema have been described in the absence of bowel symptoms.[43] Hill *et al*[44] found that postoperative complications were more common in patients with protein malnutrition, possibly as a result of impaired immunity and poor wound healing. In chronic ulcerative colitis albumin concentrations are usually normal.

Minerals and vitamins

It has become increasingly recognised that patients with Crohn's disease may suffer from various vitamin and trace element deficiencies.[3] Although clinical manifestations of these deficiencies are unusual, measurement of serum concentrations of micronutrients should be considered in any detailed nutritional assessment.

ELECTROLYTES AND TRACE ELEMENTS

Hyponatraemia and hypochloraemia may be found in patients with Crohn's disease with active or recurrent disease,[45] and Beeken[22] found low sodium concentrations in 10% of cases.

Potassium deficiency is usually present with a low plasma concentration and sometimes occurs when the plasma potassium is normal.[46 47] Correction of potassium values before surgery has been shown to reduce the complication rate and mortality.[47]

Hypocalcaemia has been reported to occur commonly in Crohn's disease,[22 40] but values must be related to the albumin concentration.[41] Hypocalcaemia usually occurs in association with hypoalbuminaemia, and if appropriate corrections are made, then true hypocalcaemia is relatively uncommon. Krawitt *et al*[48] carried out a detailed study on 31 patients and found normal serum calcium concentrations, absorption, and endogenous faecal calcium excretion compared with those of controls.

Magnesium deficiency was not widely appreciated as a complication of Crohn's disease until 1970, when Gerlach *et al*[49] described four patients with symptomatic hypomagnesaemia. Dependence on serum magnesium concentrations for diagnosis will lead to underdiagnosis of the condition. Beeken[22] found hypomagnesaemia in only nine of 63 patients. Main *et al*,[50] however, using serum and urine concentrations together as an indicator of magnesium state, found that 15 of 17 patients admitted to hospital with severe disease were deficient in magnesium. Swedish workers found clinically important magnesium deficiency in 30% of patients following intestinal resection. Diagnosis depended on muscle magnesium concentrations, which were often low in the presence of normal serum concentrations.[51]

Low plasma zinc concentrations have been reported in up to 40% of patients with Crohn's disease and often in association with impaired taste capacity.[52–55] In contrast, others found normal plasma and urine zinc concentrations.[56 57] In many of the studies there was a correlation between concentrations of plasma zinc and albumin.

VITAMINS

Various deficiency states affecting both water soluble (vitamin B complex and vitamin C) and fat soluble (vitamins A, D, E, and K) vitamins have been reported in patients with Crohn's disease.[3] The relevance to the clinical condition has not been well documented and as assays for these vitamins are not generally available measurements have little part to play in clinical practice. It is, however, important to bear these entities in mind in patients with complex nutritional disturbances.

Fat and carbohydrate absorption

Steatorrhoea can be found in up to 30% of patients with Crohn's disease.[22 34 41] Both the length of diseased small bowel and the extent of surgical resection are important determinants of the degree of steatorrhoea. In practice, however, the problem is often masked because of the associated anorexia and reduced fat intake.[58] Steatorrhoea is important because it reflects malabsorption not only of fat but also of other substances. Most of the patients studied by Pimparker *et al*[40] who had steatorrhoea also had hypoalbuminaemia, hypoprothrombinaemia, and vitamin B_{12} malabsorption.

Xylose absorption has been found to be impaired in some studies[22 35] but, on the whole, it is normal unless the entire jejunum and ileum are affected by the inflammatory process.[34 41] Lactose absorption is also generally regarded as being normal in inflammatory bowel disease.[59]

Assessment of nutritional intake

Dietary assessment of patients with chronic inflammatory bowel disease attending outpatient clinics has shown that most patients have what would normally be regarded as an adequate nutrient intake, although this may well not be sufficient for the needs of those with Crohn's disease.[60] It has been suggested that prolonged inadequate caloric intake is probably a major cause of growth failure in children with Crohn's disease.[61 62]

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Measurement of immune functions

Undernourished patients with Crohn's disease have considerable reductions in total lymphocyte numbers, total T lymphocyte and T subset counts, a reduced proportion of monocytes capable of ingesting latex particles, and reduced in vitro immunoglobulin production at low lymphocyte concentrations.[63] As few of these tests are routinely available they are of little help in normal clinical practice but may help in nutritional assessment for research purposes.

Conclusion

Malnutrition is common in patients with active inflammatory bowel disease, especially Crohn's disease. Weight loss is widely used as a simple means of identifying patients at risk of nutritional depletion, but it may be an unreliable indicator if it depends on the patient's memory, routine hospital records, or if oedema occurs as a result of hypoalbuminaemia. It is usually not difficult to recognise patients who are severely undernourished, but it may be much more difficult in those with lesser degrees of nutritional depletion. A wide range of nutritional disturbances can be found, particularly in ill patients with Crohn's disease. As more sophisticated tests to assess nutritional state become available so are more and more deficiency states being recognised as complications of inflammatory bowel disease. It is probably important to recognise appreciable nutritional deficiencies at an early stage so that appropriate treatment can be started; otherwise many patients will suffer unnecessarily from the consequences of deprivation of vital nutrients that may cause considerable morbidity. Some patients will require nutritional supplements. Careful monitoring of blood films and serum concentrations of folate, vitamin B_{12}, iron, and ferritin will act as a guide for replacement treatment. Serum calcium (and albumin), and alkaline phosphatase activity, although poor overall indicators, may be of some value in the detection of osteomalacia. These simple screening tests are likely to identify the most severe nutritional consequences of inflammatory bowel disease. Nutritional defects may, however, have more subtle effects; iron and zinc deficiency can be associated with impaired immune competence[64] and hypomagnesaemia may be associated with parathyroid failure.[65] Although the classical manifestations of nutritional depletion are uncommon, subclinical deficiencies, which may have clinical relevance, are by no means rare.

On clinical grounds, it is difficult to identify the "at risk" patient who attends the outpatient department. Simple anthropometric measurements, especially that of the mid arm circumference, provide a simple, reproducible, and convenient way of achieving this and help to identify those patients with both clinical and biochemical features of malnutrition. Consideration should be given to including these measurements in any formal assessment of nutritional state in patients with inflammatory bowel disease.

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