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Nutritional state of patients with lung cancer undergoing thoracotomy

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Abstract

Preoperative nutritional assessment was carried out on 39 consecutive patients with bronchial carcinoma who underwent thoracotomy. For 18 patients the body mass index and triceps and subscapular skinfold thickness fell below the 25th centile. In 23 patients the creatinine height index was less than 80% of the predicted value. The mean (SEM) serum albumin concentration was 40·3 (0·57) g/l (reference range 35–50 g/l) and mean (SEM) serum transferrin 1·77 (0·1) g/l (reference range 2·0–3·0 g/l). Although only three patients were hypoalbuminaemic, transferrin concentrations were depressed in 26 patients. There was a significant fall in the serum concentrations of both prealbumin and transferrin in the first postoperative week. Nutritional insufficiency was particularly severe in the four patients who developed an early bronchopleural fistula. It is concluded that protein-energy malnutrition is common in patients with operable bronchial carcinoma and that routine postoperative feeding does not prevent further depletion of circulating proteins. A larger prospective study is needed to examine the relation between preoperative nutritional state and outcome.

Protein-energy malnutrition is common in patients requiring surgery[1,2] and is associated with increased perioperative morbidity and mortality.[3–6] Controlled studies suggest that preoperative identification and treatment of nutritional deficiencies may improve the outcome of surgery,[7–9] and this has fostered a growing awareness of methods of nutritional assessment and support among general surgeons.[10]

Little attention has so far been paid to the state of nutrition of patients undergoing pulmonary surgery. Most patients are smokers undergoing thoracotomy for bronchial carcinoma, and as malignancy[11] and chronic airflow limitation[12] predispose to malnutrition these patients might be expected to be at increased risk of nutritional deficiencies. Conceivably such nutritional deficiencies will influence adversely the postoperative course of some patients whose tumours are successfully resected; this could result from impaired tissue healing,[13] undue susceptibility to infection,[14] and possibly respiratory muscle dysfunction.[15]

Nutritional assessment by clinical intuition has been largely superseded by standardised techniques with reference values derived from population studies.[16] Various anthropometric, biochemical, and functional tests may be used to assess the state of the major body compartments—that is, energy stores (mostly fat), somatic protein mass (skeletal muscle), and visceral protein mass (reflected by the serum concentrations of transport proteins synthesised in the liver). As deficiencies of the individual compartments usually coexist, the term protein-energy malnutrition is often used. We have conducted a survey of the nutritional state of patients with bronchial carcinoma before surgery to establish the prevalence of protein-energy malnutrition in this population.

Methods

Thirty nine consecutive patients with bronchial carcinoma underwent thoracotomy at the Regional Cardiothoracic Centre, Freeman Hospital, Newcastle upon Tyne, over three months. Their mean age was 61·9 years and mean (SD) FEV_1 was 2·26 (0·65) litres or 79·7% predicted. Twenty three patients underwent lobectomy and 12 pneumonectomy, and four were found to have an unresectable tumour at thoracotomy. The histological diagnosis was squamous cell carcinoma in 21 cases, adenocarcinoma in 14, and large cell undifferentiated carcinoma in four.

We screened all patients for evidence of protein-energy malnutrition before operation, using a panel of anthropometric and biochemical indicators that are widely accepted.[16,17] For analysis of the results for each variable the patients were treated as a group; we did not derive a multivariable nutritional assessment index for individual patients.

Energy reserves were estimated from the body mass index and the sum of triceps and subscapular skinfold thickness.[16,17] The body mass index was calculated by dividing the patient's weight (kg) by the square of the height (m). Skinfold measurements were made by one operator with standard calipers, who took the average of three recordings at each site. The results obtained for the body mass index and triceps-subscapular skinfold thickness were compared with values in standard reference tables and expressed as percentiles after correction for age and sex.[16–19] For comparison, the weight-height data were also expressed as percentages of ideal body weight.[16,17]

Protein was assessed on the basis of the creatinine height index[20] and serum concentra-

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tions of albumin and transferrin.[21 22] The creatinine height index (reflecting somatic protein mass[16 17]) was obtained by expressing the patient's urinary creatinine excretion as a percentage of a reference value corrected for sex and height.[20] Creatinine excretion was measured in a 24 hour urine collection carried out in the ward before the day of surgery. Serum albumin concentration was determined by a standard colorimetric method and serum transferrin and prealbumin concentrations by radial immunodiffusion.

To assess the adequacy of nutritional support, we made serial measurements of serum transferrin and prealbumin: the baseline serum sample taken on the day before surgery (day 0) was followed by further samples on the second, fourth, and six postoperative days (days 2, 4, and 6). Both of these proteins have a relatively short circulating half life (transferrin eight days, prealbumin two days) and so their concentrations change measurably in response to acute nutritional stresses,[23] providing a crude index of nitrogen balance.[24]

Finally, we recorded all major complications.

Results

ANTHROPOMETRIC MEASUREMENTS

The distribution of body mass indices and triceps-subscapular skinfold thicknesses showed a substantial skew towards the lower percentile bands, 18 patients falling below the 25th percentile (fig 1*a* and 1*b*). When the weight-height data were expressed as percentages of ideal body weight eight patients were in the range 80–90% and six patients were below 80%.

CREATININE HEIGHT INDEX

Twenty three patients had a creatinine height index below 80% predicted (fig 1*c*) and eight patients had values below 60%.

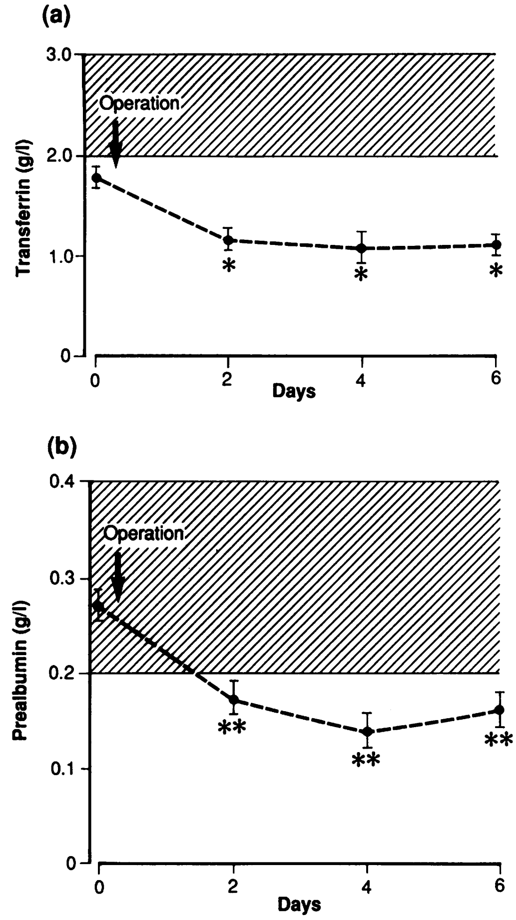

Figure 2 (a) Serum transferrin and (b) serum prealbumin concentrations before surgery (day 0) and on days 2, 4, and 6 after surgery. All values are expressed as means with SEM. The reference range (hatched) is 2·0–3·0 g/l for transferrin and 0·2–0·4 g/l for prealbumin. Asterisks indicate significant change (p < 0·001, paired t test) from day 0.

SERUM PROTEINS

The mean (SEM) serum albumin concentration for the group was 40·3 (0·57) g/l; only three patients had values below 35 g/l (reference

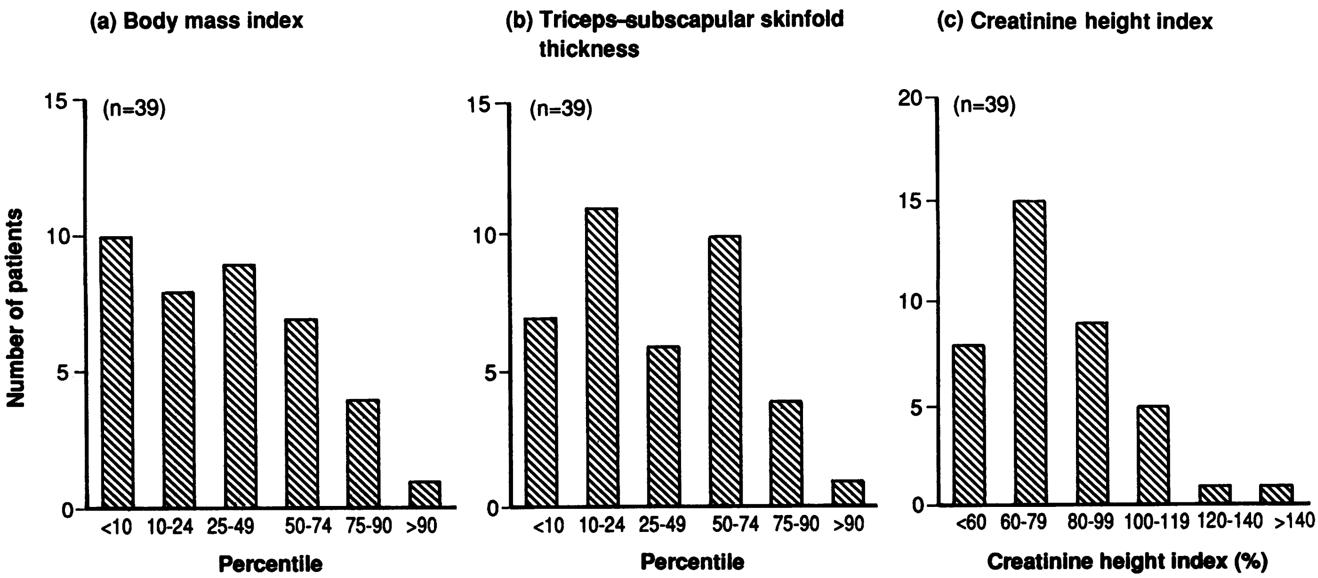

Figure 1 Distribution of (a) body mass index, (b) triceps-subscapular skinfold thickness, and (c) creatinine height index according to percentage band from a reference population (mean = 100%).

Preoperative nutritional indices of the patients who developed bronchopleural fistula

Patient No	*BMI centile*	*Skinfold centile*	*CHI (%)*	*Albumin* (g/l)*	*Transferrin* (g/l)*
3	<10	<10	41·3	40	1·90
11	<10	10–25	72·8	38	1·43
17	10–25	25–50	67·0	42	1·81
33	<10	<10	65·7	42	1·40

*Serum concentration; reference range 35–50 g/l for albumin and 2·0–3·0 g/l for transferrin.
BMI—body mass index; skinfold—sum of triceps and subscapular skinfold thickness; CHI—creatinine height index.

range 35–50 g/l). By contrast, mean (SEM) serum transferrin was reduced at 1·77 (0·1) g/l (reference range 2·0–3·0 g/l) and 26 patients had values below the reference range. There was a significant fall in transferrin and prealbumin from day 0 to day 2 ($p < 0·001$, paired *t* test; fig 2), and the concentrations of both proteins were still low on day 6. This fall was seen in patients with normal as well as subnormal preoperative values.

COMPLICATIONS

The following major postoperative complications developed: pneumonia (eight patients), bronchopleural fistula (four), haemorrhage (one), pulmonary embolus (one). There were three deaths. Bronchopleural fistula, fatal in two of the four cases, occurred more frequently than expected. In all four patients complete resection of the tumour had been achieved. All four had evidence of gross protein-energy malnutrition in the preoperative screening, though none was hypoalbuminaemic (table). There was no clear association between preoperative malnutrition and any other postoperative complication.

Discussion

Various anthropometric, biochemical, and functional tests have been proposed to assist in the diagnosis of protein-energy malnutrition,[16 17] but there is no general agreement about the best approach for nutritional assessment of individual patients.[6 16 25] The prevalence of nutritional deficiencies in a population, however, can be estimated by using several nutritional indices in all subjects and comparing the distribution of values for each index with that in a normal population. This approach avoids the problems associated with defining the nutritional state of individual patients. Although the reference tables are derived from white North Americans,[16–19] this is unlikely to lead to a large discrepancy when they are applied to a broadly similar population such as the one that our patients were drawn from. These standards are widely used for clinical assessment by dieticians and nutritional scientists in Britain.[17]

Our results suggest that protein-energy malnutrition is common in patients with operable bronchial carcinoma. Serum albumin concentration is the only one of these nutritional indices routinely available to clinicians, but this was normal in 36 of the 39 patients. Like Mullen *et al*,[26] we found serum transferrin concentration to be a more sensitive biochemical index of protein depletion. The low frequency of hypoalbuminaemia may have contributed to a tendency to underestimate the nutritional problems of such patients in the past.

Several factors may have contributed to the nutritional deficiencies in these patients. Malignant tumours may cause cachexia by various mechanisms even before the development of metastases.[11] Chronic airflow limitation is known to predispose to malnutrition,[12] though the mean FEV_1 was 80% predicted and none of the patients had evidence of severe emphysema. Chronic heavy tobacco consumption may also be associated with a poor dietary intake independently of bronchial carcinoma or emphysema.

The fall in serum transferrin and prealbumin in the week after surgery was probably due to a combination of inadequate postoperative feeding and the catabolic effects of surgery on protein metabolism.[27] In uncomplicated cases patients were allowed an unrestricted diet from 24–48 hours after surgery, but it would often take several more days for their dietary intake to return to normal. This may have important implications for tissue healing. Recent evidence suggests that wound healing is extremely sensitive to short term reductions in nutritional intake and may become impaired without there being evidence of major protein-energy malnutrition,[13] while in malnourished patients nutritional repletion enhances wound healing long before there is any measurable restoration of protein and energy stores.[28]

The unusually high incidence of bronchopleural fistula was probably due to chance clustering of cases; the overall incidence of this complication in our centre is much lower. Nevertheless, it is of interest that all four patients had evidence of multiple nutritional deficiencies (table), raising the possibility that malnutrition may have been one factor contributing to the development of this complication—for example, by adverse effects on healing of the bronchial stump.[23] To confirm this, however, would need a prospective comparison of outcome in patients of differing preoperative nutritional state (see below).

If the use of nutritional screening techniques in the preoperative workup of patients with bronchial carcinoma is to be justified we need to show that the techniques identify individual patients with an increased likelihood of developing complications and that nutritional support improves the outcome in these "high risk" patients. Proving a relation between protein-energy malnutrition and outcome would require a larger prospective study looking at the nutritional state of individual patients as opposed to the population approach adopted in this survey. Numerous methods have been proposed for assessing individual patients, including elaborate formulae for multivariable indices.[3 5] General surgical experience, however, suggests that high risk patients can be just as accurately identified by measuring serum transferrin and a functional test such as handgrip or respiratory muscle strength.[6 25 29] These patients could be entered into a prospective trial to assess the benefit of nutritional interventions, such as outpatient dietary supplementation and perioperative hyperalimentation with enteral tube feeding. Experience in other groups of patients suggests that it might be possible to reduce morbidity and perhaps mortality by such measures,[7–9] though substantial numbers of patients may be required to show an effect.[30]

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