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## **PROCEEDINGS OF THE NUTRITION SOCIETY**

### **ABSTRACTS OF COMMUNICATIONS**

*The Four Hundred and Thirteenth Meeting of the Nutrition Society (One Hundred and Sixty-fourth of the Scottish Group) was held in the Coylumbridge Hotel, Aviemore on Thursday and Friday, 25/26 April 1985, when the following papers were presented:*

**The effects of continuous or nocturnal feeding on postoperative metabolism and catecholamine excretion.** By I. T. CAMPBELL<sup>1</sup>, R. P. MORTON<sup>2</sup>, S. JUDD<sup>3</sup>, I. A. MACDONALD<sup>4</sup>, L. SHAPIRO<sup>5</sup> and P. M. STELL<sup>2</sup>, *University Departments of <sup>1</sup>Anaesthesia; <sup>2</sup>Otolaryngology; <sup>3</sup>Dietetic Department, Royal Liverpool Hospital, Liverpool; <sup>4</sup>Department of Physiology and Pharmacology, University of Nottingham and <sup>5</sup>Department of Clinical Chemistry, St James's University Hospital, Leeds*

In a previous study (Campbell *et al.* 1983), patients given 11–12 MJ/d enterally by continuous infusion after major head and neck surgery had high oxygen consumption ( $\dot{V}O_2$ ) and worse nitrogen balance than patients given similar quantities as a single dose every 2 h during the daytime only. In animals, patterns of feeding affect metabolism: it was postulated that to function most appropriately in these patients, the liver required a period of rest in the 24 h.

Two groups of nine patients (comparable in terms of age and nutritional status) were fed by nasogastric tube, using a pump, for 5 d after major head and neck surgery, building up the rate to 10 MJ/24 h on days 2–5. One group was fed for 24 h/d, the other overnight between 17.00 and 09.00 hours, thus maintaining an intermittent pattern, avoiding the abdominal discomfort associated with single dose feeding and leaving the patient free and mobile during the day.  $\dot{V}O_2$  was measured at 08.00–09.00 hours preoperatively and at 08.00–09.00 and 16.30–17.00 hours postoperatively; 24 h urinary nitrogen and catecholamine excretion, blood levels of alanine aminotransferase (*EC* 2.6.1.2.),  $\gamma$ -glutamyl transferase (*EC* 2.3.2.2) and alkaline phosphatase (*EC* 3.1.3.1), inorganic phosphate, glucose, insulin and cortisol, were measured daily for 5 d. Blood was sampled after the morning  $\dot{V}O_2$  measurement.

O<sub>2</sub> consumption in the two groups was comparable preoperatively but over the 5 d was lower in the night-fed group ( $P < 0.01$ ). Cumulative N balance was worse in those fed at night (–19.6 (SE 7.8) g) than those fed continuously (–0.3 (SE 4.2) g) ( $P < 0.05$ ). There was no significant difference between the groups in liver enzymes, inorganic phosphate or cortisol but, on day 5, glucose and insulin were significantly higher in the night-fed than in the continuously-fed patients ( $P < 0.05$ ). There was no significant difference between the two groups in urinary noradrenaline excretion but, in the continuously fed subjects, 24 h urinary adrenaline excretion was significantly higher ( $P < 0.05$ ) and urinary dopamine excretion higher ( $P < 0.01$ ) on days 3, 4 and 5.

Postoperative feeding at night only was associated with lower  $\dot{V}O_2$ , worse N balance and less dopamine and adrenaline excretion than in those patients fed continuously. The higher O<sub>2</sub> consumption with continuous feeding may be due to higher levels of sympathoadrenal activity.

Campbell, I. T., Morton, R. P., Cole, J., Raine, C. H., Shapiro, L. M. & Stell, P. M. (1983). *American Journal of Clinical Nutrition* **38**, 870–876.

**Lung cancer: a starving disease?** By C. GRIFFIN, CATHERINE ROYCE, M. DE LA HUNT and S. J. KARRAN, *University Surgical Unit, Southampton General Hospital, Tremona Road, Southampton SO1 6HU*

Protein-energy malnutrition is the most common secondary diagnosis in cancer patients. The present study examines the relation between nutritional status of the patient, treatment and complications. Nutritional assessment comprising anthropometric and biochemical variables was performed in seventy-six patients with lung cancer before treatment and thereafter on a 3-week basis. Complications during treatment were also recorded.

Pretreatment mean grip strength and mid-arm muscle circumference were below normal levels as obtained by Klidjian *et al.* (1982), although the biochemical indices of zinc, transferrin and albumin were within normal ranges.

Patients with 'extensive disease', as assessed by Roswit *et al.* (1968), had significantly lower grip strength and greater weight loss than the limited-disease group ( $P < 0.05$ ). There was no significant difference in any nutritional index in the different histological groups at the same disease stage. Results in the Table show that patients undergoing chemotherapy showed a significant deterioration in grip strength, mid-arm muscle circumference, weight loss and % ideal body-weight from pretreatment values during the course of the first cycle of chemotherapy. This pattern was associated with a significant increase in complications.

Table. *Changes recorded during chemotherapy*

	Grip strength (kg)	Mid-arm muscle circumference (mm)	Wt loss (kg)	Ideal body-wt (%)	Complication score
Mean change	-6.4	-37	4.5	-3.2	2.6
$P <$	0.02	0.002	0.02	0.002	0.03

No single variable gave accurate prognosis of treatment-related complications. Radiotherapy patients showed no significant changes in their nutritional indices or complication score over the cycle of therapy. On ethical grounds no control group was used in this study.

The present study has shown that the nutritional status in lung cancer patients deteriorates during chemotherapy and is associated with complications of such treatment. Reversal of this trend may offer a better quality of life during and following therapy.

Klidjian, A. M., Archer, T. J., Foster, K. J. & Karran, F. J. (1982). *Journal of Parenteral and Enteral Nutrition* 6 (2), 119-121.

Roswit, B., Patno, M. E., Rapp, R., Veinbargs, A., Feder, B., Stuhlbag, J. & Reid, C. B. (1968). *Radiology* 90, 688-697.

**Can postoperative peripheral feeding reduce complications following major surgery?** By CATHERINE ROYCE, G. L. SUTTON and S. J. KARRAN, *University Surgical Unit, Southampton University Hospital, Tremona Road, Southampton SO1 6HU*

Perioperative nutritional support using total parenteral nutrition (TPN) may reduce postoperative mortality and morbidity, particularly postoperative sepsis (Mullen *et al.* 1980) but prophylactic TPN is not widely used by surgeons in this country. The present study explores the value of postoperative peripheral vein feeding.

101 consecutive patients admitted for major excisional surgery for histologically proven carcinoma of the oesophagus or bladder were studied prospectively. Using sealed envelopes, those who underwent radical surgical excision were allocated to one of the following feeding regimens on the first postoperative day: (a) 1 g isotonic amino acid solution (Perifusin)/kg per d; (b) 1 g Perifusin/kg per d and 500 ml fat emulsion (Intralipid, 200 g/l); (c) dextrose (40 g/l)–saline (9 g sodium chloride/l) in equivalent volumes, i.e. 40–50 ml/kg per d.

Twenty-one of twenty-four patients with carcinoma of the bladder were operable and underwent total cystectomy and formation of an ileal conduit, and nineteen of the twenty-one entered the feeding trial (two were excluded because of preoperative metabolic problems: hypercalcaemia and uraemia). Forty-seven of seventy-seven patients with carcinoma of the oesophagus were operable and had radical surgery (nineteen Ivor Lewis oesophagectomies, twenty-eight left thoraco-abdominal gastrectomies): all but one patient (referred immediately for TPN) entered the feeding trial. The intravenous regimen was continued in each case until adequate oral fluid intake was re-established. All patients were closely observed for complications during their postoperative recovery.

Regimen . . .	Amino acids (a)	Amino acids + lipids (b)	Dextrose–saline (c)
Patients with septic complications	0/24 (0%)	2/20 (10%)	10/21 (48%)

Chi square test:  $P = 0.01$  for a v. c and b v. c.

Postoperative complications were significantly reduced in patients receiving peripheral parenteral nutrition (PPN) compared with those receiving dextrose–saline only. This reduction was due to a lower rate of sepsis in fed patients. There was no significant difference between fed and unfed patients for other complications.

These results show that short-term, postoperative PPN reduced morbidity due to septic complications.

Mullen, J. L., Buzby, G. P., Matthews, D. C., Smale, B. F. & Rosato, E. F. (1980). *Annals of Surgery* 192, 604–613.

**Preoperative nutrition: a simple classification for the selection of patients and its relation to clinical assessment.** By R. A. PETTIGREW, *University Department of Surgery, Auckland Hospital, Auckland, New Zealand*

There is still a need for a simple clinical classification of surgical patients which selects those who may benefit from preoperative nutritional support. Using a similar classification to that used for childhood malnutrition, 218 patients preparing for major gastrointestinal resections were prospectively studied. The classification was based on a surgical risk measurement (high risk, plasma albumin <32 g/l) and a nutritional depletion measurement (depletion, weight/height<sup>2</sup> <10th percentile (NZ standards) with weight loss). Thirty-nine patients (18%) developed major complications postoperatively or died. Classification of the patients into the four categories and their complication rates are given in the Table.

Risk category	Not depleted			Depleted		
	n	With complications		n	With complications	
		n	%		n	%
Low (plasma albumin >32 g/l)	129	20	16	64	8	13
High (plasma albumin ≤32 g/l)	13	7	54**	12	4	33NS

NS, not significant; \*\*P = 0.003

The group with the highest complication rate (high risk, not depleted) had significantly more patients with preoperative sepsis (46%) than the other groups (2-17%) (Fisher's Exact Test, P = 1.2 × 10<sup>-5</sup>).

Using a linear analog scale, the operating surgeons assessed 156 consecutive patients and their twenty-six patients at highest risk (17%) were classified. Although the surgeons were picking significantly more patients in the depleted and high-risk categories than in the other groups, they were only able to identify correctly patients who developed postoperative complications in the high-risk, not depleted category.

It is concluded that depleted patients with plasma albumin >32 g/l do not need nutritional support to reduce the risk of postoperative complications. Patients with lower plasma albumin who are not depleted are likely to develop sepsis and are easily identified by surgeons as high risk. The group of patients most likely to benefit from nutritional support (depleted patients with a low plasma albumin) are few (6% in this study) and are not easily selected by the surgeon as high-risk patients.

**Nutritional status in rheumatoid arthritis.** By G. F. BATSTONE, M. HELLIWELL, E. J. COOMBES, B. J. MOODY and J. C. ROBERTSON, *Department of Rheumatology and Chemical Pathology, Salisbury General Infirmary, Wiltshire SP2 7SX*

It is well recognized that disease processes can interfere with adequate nutrition and even lead to a malnourished state. Deficiencies of several specific nutrients may occur in patients with rheumatoid arthritis (RA) but there has been no comprehensive study concerning the nutritional status in these patients.

A nutritional assessment, based on standard methods, was carried out in fifty unselected RA patients (thirty female) and an equal number of matched controls. Of the anthropometric measurements, the body-mass index and triceps skin-fold thickness values in men and women were significantly reduced in RA patients compared with controls. Upper arm muscle circumference was significantly less in male but not in female RA patients compared with controls.

In addition, serum albumin, transferrin, retinol-binding protein, thyroxine-binding pre-albumin, zinc and folic acid were significantly lower in the RA subjects.

	RA patients			Controls			P<
	Mean	SD	%*	Mean	SD	%*	
Body mass index	22.7	3.6	30	25.5	3.2	4	0.001
Albumin (g/l)	39.3	4.1	14	43.5	3.1	—	0.001
Transferrin (g/l)	2.8	0.5	18	3.3	0.6	—	0.001
Zinc (mmol/l)	12.3	2.3	8	13.5	2.2	—	0.05
Retinol-binding protein (mg/l)	53.7	18.9	26	68.2	13.9	—	0.001
Thyroxine-binding pre-albumin (g/l)	0.21	0.09	24	0.27	0.07	—	0.001
Folic acid (µg/l)	3.2	1.5	20	3.8	1.6	6	0.05

\*Values indicate percentage of patients with results below the reference range.

Thirteen (26%) RA patients had combined anthropometric and biochemical abnormalities which indicated a malnourished state, while all fifty controls had normal nutritional status. Malnourished patients could not be distinguished from the remaining RA patients by a difference in their dietary intake, age or disease duration, but their disease was more active as shown by significantly higher erythrocyte sedimentation rate, C-reactive protein and  $\alpha$ -1-antichymotrypsin measurements. Significant inverse correlations were found between some biochemical measurements of nutrition and indices of disease activity. Our results suggest that in RA either the severity of disease adversely affects the nutritional status or that whatever process initiates the acute phase response also causes diminished synthesis of proteins commonly thought to be nutritional markers.

**Postoperative food intake of elderly fracture patients.** By J. W. T. DICKERSON, J. FEKKES and S. M. GOODINSON, *Divisions of Nutrition and Food Science and Nursing, Department of Biochemistry, University of Surrey, Guildford, Surrey GU2 5XH* and M. W. J. OLDER, *Department of Orthopaedic Surgery, Royal Surrey County Hospital, Guildford, Surrey GU2 5XX*

Older *et al.* (1980) reported that elderly women with femoral fractures had an inadequate postoperative food intake. Improvements in hospital catering and food distribution prompted us to repeat the study.

We have measured the voluntary food intake of eighteen patients (mean age 84 years, range 69–101 years) with femoral neck fractures. All food consumed on days 3, 7 and 14 after operation was weighed and the nutrient content calculated from computerized tables of food composition (Paul & Southgate, 1978). Mean intakes on days 3, 7 and 14 were: energy (kJ (kcal)) 3218 (769), 4192 (1002) and 3565 (852), and protein (g) 28, 42 and 32 respectively. Intakes of individual patients differed considerably on each day with some patients having very low intakes. Some patients had a zero intake of at least one vitamin on one or more days. Patients with low intakes on day 3 had not substantially increased their intake on day 14. Comparison of the intakes with the UK recommended amounts (Department of Health and Social Security, 1979) for healthy individuals of the same age showed that one-third of the patients consumed less than 50% of the recommended amount of protein, calcium, thiamin and vitamin C, half of them less than this amount of energy, riboflavin, iron and vitamin A and none of them consumed as much as 50% of the amount of vitamin D recommended for the housebound.

We have confirmed that in spite of adequate provision of food, elderly fracture-patients do not have a satisfactory intake. Prevention of postoperative complications including mental confusion (Older & Dickerson, 1982) is essential if the desirable objectives of early weight-bearing and rehabilitation are to be achieved. Supplementary tube feeding of this sort of patient has been found (Bastow *et al.* 1983) to reduce rehabilitation time and hospital stay. However, additional supplements of vitamins, in particular thiamin and vitamins C and D, may be required.

Bastow, M. D., Rawlings, J. & Allison, S. P. (1983). *British Medical Journal* **287**, 1589–1592.

Department of Health and Social Security (1979). *Report on Health and Social Subjects*, no. 15. London: H.M. Stationery Office.

Older, M. W. J. & Dickerson, J. W. T. (1982). *Age and Ageing* **11**, 101–107.

Older, M. W. J., Edwards, D. & Dickerson, J. W. T. (1980). *British Journal of Surgery* **67**, 884.

Paul, A. A. & Southgate, D. A. T. (1978). *McCance and Widdowson's The Composition of Foods*, MRC Special Report no. 297. London: H.M. Stationery Office.

**Effects of radiotherapy on food acceptability in cancer patients.** By J. W. T. DICKERSON, MAIR EVANS and SUSAN HOLMES, *Divisions of Nutrition and Food Science and Nursing, Department of Biochemistry, University of Surrey, Guildford, Surrey GU2 5XH*

Cancer and its treatment may cause malnutrition (Dickerson, 1984). Food aversions (Bernstein & Sigmundi, 1980) and changes in taste (De Wys, 1978) may significantly contribute to a reduction in food intake as too may emotional and psychological reactions (Holland, 1977). An account (MacCarthy-Leventhal, 1959) of a physician's experience of the changes in taste sensation following radiotherapy (RT) for cancer of the pharynx emphasized the need to appreciate these problems. We have studied some of these problems by means of a questionnaire, visual analogue scales and subjective assessment in twenty out-patients on RT, twenty out-patients not on RT and thirty-six in-patients on RT. Patients in the respective groups were unselected but there were similar numbers in each group with tumours in the breast, pelvis and head and neck. Their ages were 40–87, 25–74 and 35–77 years respectively.

No food aversions were experienced by 45% of out-patients and 40% of in-patients receiving RT. Of those who had aversions, the foods most frequently affected were red meat, fish, coffee and vegetables. Aversions were more common in patients with secondaries and in those with breast, pelvic and head and neck cancers. Skin-cancer patients had no aversions. One-third of in-patients and half the out-patients with taste problems found that these persisted for more than a year. 25% of in-patients and 15% of out-patients on RT missed at least one meal per day. The most important meal changes were the addition of breakfast and the refusal of dinner. In-patients were more depressed than out-patients and depression was negatively correlated with appetite score. Patients who had lost most weight tended to have more radiation sickness.

The effect of RT that may have nutritional consequences vary from patient to patient. Only by understanding these effects can the food intake of patients receiving RT be maintained. This requires understanding and action by all those involved in patient care both in hospital and in the community.

Bernstein, I. L. & Sigmundi, R. A. (1980). *Science* **209**, 416–418.

De Wys, W. D. (1978). *Journal of Human Nutrition* **32**, 447–453.

Dickerson, J. W. T. (1984). *Journal of the Royal Society of Medicine* **77**, 309.

Holland, J. C. B. (1977). *Cancer* **27**, 373–367.

MacCarthy-Leventhal, E. M. (1959). *Lancet* **ii**, 1138.

**Assessment of an in vitro serum protein Zn-binding test in human nutrition.** By G. S. FELL, T. B. LYON, M. PHILLIPS and W. FRASER, *Department of Pathological Biochemistry, Glasgow Royal Infirmary, Glasgow G3 7ER*

Serum or plasma zinc concentration is not a sensitive index of Zn deficiency. An in vitro procedure for measuring the binding capacity of serum proteins for Zn was developed by Kincaid & Conrath (1979) for calves and by Roth & Kirchgessner (1980) for rats.

We have investigated the laboratory procedures and developed a method for human nutritional studies. Serum (1 ml) is mixed with zinc nitrate solution (1 ml, 80  $\mu\text{mol Zn/l}$ ). Magnesium carbonate (100 mg) is added, mixed for 30 min, and then centrifuged (10 min, 3000 rpm). Zn is measured in the supernatant fluid and the original serum sample by flame atomic absorption spectrophotometry. The percentage Zn-binding capacity is then calculated. We have noted the following:

(1) Increasing the concentration of added Zn above 80  $\mu\text{mol/l}$  causes an abrupt rise in the observed percentage binding capacity, therefore the concentration of the added Zn solution must be closely controlled.

(2) The concentration chosen of 80  $\mu\text{mol Zn/l}$  does not fully saturate the available Zn-binding sites on serum proteins. Gel filtration studies show that all added Zn (up to  $\geq 1000 \mu\text{mol/l}$ ) is bound to serum proteins.

The test is therefore a relative measure of each different serum sample's ability to bind added Zn.

We have determined that six healthy subjects had a mean serum protein Zn-binding capacity of 75 (SE 2.4) % and that this value fell during an oral Zn tolerance test. The mean value found for man is similar to that quoted by Roth & Kirchgessner (1980) of between 60 and 70% for optimally fed rats. The Zn-binding capacity test has been applied to patients receiving intravenous nutrition including 100  $\mu\text{mol Zn/d}$ . As Zn supplementation proceeds, the initially high values of greater than 80% fall to less than 50–60% as serum protein Zn-binding capacity is taken up. The usefulness of this test procedure in relation to other assessments of serum Zn and serum albumin-Zn relations is presently under consideration.

Kincaid, R. L. & Conrath, J. D. (1979). *Journal of Dairy Science* **62**, 572–576.

Roth, H. P. & Kirchgessner, M. (1980). *Research in Experimental Medicine (Berlin)* **117**, 213–219.

**Intravenous nutrition and hepatic dysfunction: a retrospective study.** ByJ. F. R. ROBERTSON<sup>1</sup>, O. J. GARDEN<sup>1</sup> and A. SHENKIN<sup>2</sup>, *Departments of*  
<sup>1</sup>*Surgery and* <sup>2</sup>*Biochemistry, Glasgow Royal Infirmary, Glasgow G3 7ER*

Hepatic dysfunction with abnormalities in liver function test (LFT) has been reported as the most common metabolic complication of intravenous nutrition (IVN) but its aetiology is not clear (Woolfson, 1983). Abnormalities in 127 general surgical patients who had a course of IVN have been reviewed. Only twenty-six patients had LFTs considered to be normal on commencing IVN and they were included in this retrospective study. Venous blood samples were taken on commencing IVN (i.e. week 1) and at weekly intervals thereafter.

(Median values with their ranges in parentheses)

Week . . .	1	2	3	4	5	6	7
No. of patients . . .	26	26	18	14	13	10	7
	Reference range						
LFT							
Bilirubin (μmol/l)	13.5 (3-22)	12.5 (3-91)	14.5 (4-105)	10 (6-53)	14 (7-114)	12.5 (6-68)	13 (6-49)
AST (units/l)	21 (12-48)	27 (10-177)	34* (9-76)	39.5** (16-182)	34 (10-53)	29.5 (13-46)	17 (13-31)
ALT (units/l)	18 (<55)	22.5 (7-109)	40.5** (8-125)	42* (4-260)	21* (12-118)	26 (10-76)	21 (10-37)
AP (units/l)	184 (80-280)	280.5** (110-673)	359.5** (212-703)	365** (175-789)	370** (115-570)	302** (185-768)	345** (212-586)
γGT (units/l)	31 (<36)	81** (17-447)	95.5** (33-275)	90.5** (47-271)	69.5** (32-190)	52** (25-200)	56 (4-170)
No. of patients for γGT	20	23	16	12	12	8	5

Significantly different from values for week 1 (Mann-Whitney U test): \* $P < 0.05$ , \*\* $P < 0.01$ .

No significant elevation in bilirubin was observed. There was a transient increase in hepatocellular enzymes, aspartate aminotransferase (AST, *EC* 2.6.1.1) and alanine aminotransferase (ALT, *EC* 2.6.1.2.), with a maximum at the beginning of week 4. Alkaline phosphatase (AP, *EC* 3.1.3.1) rose more rapidly than the aminotransferases and this elevation was prolonged beyond week 9. Serum γ-glutamyl transferase (γGT, *EC* 2.3.2.2) was not used as an exclusion criterion; however, it became abnormal in all patients by week 4.

Patients with major sepsis during IVN were found to have almost double the incidence of abnormal LFT values (41%) compared with patients with no evidence of sepsis (22%). Patients with below normal anthropometric measurements on commencing IVN were also more likely to develop abnormalities in AST, ALT, AP or γGT.

The clinical significance of these biochemical abnormalities remains uncertain since none appeared to be associated with adverse clinical effects.

Woolfson, A. M. J. (1983). In *New Aspects of Clinical Nutrition*, pp. 530-539 [G. Kleinberger and G. Deutsch, editors]. Basel: Karger.

**Improvement in nutritional status of psychogeriatric patients on hospitalization.** By ANNE GREER, *Department of Psychiatry, Gartloch Hospital, Glasgow* and D. M. MCBRIDE and A. SHENKIN, *Department of Biochemistry, Glasgow Royal Infirmary, Glasgow G3 7ER*

Nutritional deficiencies have been implicated in the pathophysiology of various mental disorders. Institutionalization has been associated with nutritional deficiencies and the elderly are at particular risk, especially those with senile dementia (Sneath *et al.* 1973). The aim of our study was to assess the vitamin and essential mineral status of acute and long-stay psychogeriatric patients.

Group 1 consisted of sixty-four acute admissions (median age 78 (range 65–92) years). These were divided into those suffering from functional illnesses (group 1a, *n* 21) and those suffering from dementia (group 1b, *n* 43). Group 2 consisted of forty-nine long-stay psychogeriatric patients (median age 79 (range 67–91) years) who had been in hospital for a minimum of 1 year (median period 4.5 (range 1–52) years). Group 2 was also divided into those with functional illnesses (group 2a, *n* 12) and those with dementia (group 2b, *n* 37).

Significant differences (Wilcoxon rank sum test) between groups 1 and 2 are shown in the Table (median values with their ranges in parentheses).

	Vitamin B <sub>1</sub> (% activation of erythrocyte transketolase)	Vitamin B <sub>6</sub> (% activation of erythrocyte transaminase)	Erythrocyte folate (mg/l)	Serum levels (μmol/l) of:		
				Retinol	Vitamin E	Copper
Reference range	<25	<150	106–614	1.0–3.5	14–39	12–25
Group 1	13 (<2–37)	63 (4–311)	169 (76–795)	1.8 (0.9–3.8)	26 (14–47)	22.5 (13.5–31)
Group 2	8 (<2–25)	47 (3–100)	204 (85–708)	2.2 (1.1–6.4)	23 (9–48)	20.5 (10–31.5)
<i>P</i> <	0.01	0.01	0.02	0.01	0.02	0.01

No significant differences were observed between the groups with respect to vitamin B<sub>2</sub> status, or serum vitamin B<sub>12</sub>, folate, vitamin C, magnesium, zinc, copper, iron, albumin or transferrin. In group 1, abnormally low values were found in seven out of fifty-eight patients for vitamin B<sub>2</sub> status, thirteen out of fifty-four patients for serum vitamin C, seventeen out of sixty-one patients for serum Zn and thirteen out of fifty-nine patients for serum Fe, whereas in group 2 the respective frequencies were zero out of forty-nine, five out of thirty-eight, ten out of forty-eight and six out of forty-two patients. The difference in frequency for vitamin B<sub>2</sub> was statistically significant ( $\chi^2$  test). On admission, group 1b had significantly lower serum concentrations only of Zn and vitamin B<sub>12</sub> compared with those in group 1a. Group 2b had significantly higher levels of vitamins A, B<sub>1</sub>, B<sub>2</sub>, B<sub>12</sub> and erythrocyte folate than group 1b. These results indicate that nutritional deficiency may occur in both acute functional illnesses and senile dementia. In our experience, many patients who have been hospitalized for some time show improvement in their nutritional status compared with their status on admission to hospital.

Sneath, P., Chanarin, I., Hodkinson, H. M., McPherson, C. K. & Reynolds, E. H. (1973). *Age and Ageing* 2, 177–182.

**Value of preoperative parenteral feeding in patients with cancer of the oesophagus undergoing major surgery.** By K. MOGHISSI, M. DENCH and J. PEARSON, *Humberside Cardio-thoracic Surgical Centre, Castle Hill Hospital, Cottingham, Hull HU16 5JQ*

In 1982 we set up a study of the value of preoperative intravenous feeding in patients with malignant oesophageal obstruction. By December 1984, eighty-seven patients had entered this study of whom thirty-four were found to be inoperable and were excluded. The remaining fifty-three were divided into two groups: group B ( $n$  25) received supplementary parenteral nutrition but group A ( $n$  28) did not. All patients had clinical and biochemical nutritional studies carried out, in addition to nitrogen balance, in four phases: phase 1, on admission; phase 2, preoperatively; phase 3, on the 4th and 5th postoperative days; phase 4, on the 11th and 12th postoperative days (near discharge).

All patients were operated on by the same team and received identical postoperative management. Patients were observed postoperatively with regard to wound sepsis, pleuropulmonary and general infection. Wound healing, outcome and general condition were also considered. They received total parenteral nutrition for 6–7 d followed by the introduction of normal foods. They were assessed on the basis of (1) mortality, (2) infective complications and wound healing, (3) duration of hospital stay and (4) matching the patients, particularly those with complications, of the two groups. There were no significant differences between the two groups with regard to age and sex.

There were four deaths in the entire series, all in group A (mortality 15.3%). With regard to postoperative complications, eight patients in group A had wound sepsis or pleuropulmonary infection as compared with two patients in group B. Four patients in group A had wound dehiscence as compared with one in group B. Duration of hospitalization in group A was 20.3 d/patient (four deaths excluded) compared with 16.7 d for group B patients.

Preoperative nutritional matching had ensured that there was no significant difference between the groups: the patients in group A who died or who had complications were no different from the patients in group B who did not die or had no complications. The preliminary conclusion we have drawn is that the supplementary preoperative parenteral feeding in oesophageal-cancer patients undergoing surgery is useful. However, some means of identifying the patients at risk should be found as we believe not all patients would require preoperative parenteral feeding. The study is continuing.

**When and how should nutrition be taught to medical students?** By AILEEN BRETT, D. J. GODDEN and R. A. KEENAN, *Raigmore Hospital, Inverness IV2 3UJ*

Despite the important role nutrition plays in good medical practice, historically it rarely has been considered an integral component of medical education (Gray, 1983). We have, therefore, examined by means of a questionnaire, medical students' knowledge of nutritional principles and attitudes towards nutrition education. A questionnaire was completed by eighty students during their clinical training. Fifteen factual questions on the assessment of nutritional status and requirements, and energy values of major nutrients were included, together with fifteen on attitudes to adequacy of their nutrition education, their competence in prescribing nutrition and the role of the dietitian.

Nutrition requirements were recognized to increase during illness or infection by 97% but only 36% knew how to assess nutritional status and 17% knew the average daily protein intake. Energy equivalents (kJ or kcal) for 1 g protein, carbohydrate, and fat were known to 40%, 47% and 26% respectively. Two-thirds would encourage the general public to increase their intake of bread and potatoes and all appreciated that dietary fibre acts as a faecal bulking agent; 83% were unaware, however, that fibre has metabolic effects. Only 5% knew the protein: nitrogen value and 58% failed to recognize the limited body storage of water-soluble vitamins.

The students' attitudes to nutrition were encouraging. They all felt that adequate nutritional support was necessary for hospital patients, although only 13% felt competent to prescribe it and 87% requested more teaching on practical aspects of nutrition. Dietitians were favoured as teachers by 26%, clinicians alone by 7% and combined teaching by 41%; 26% failed to identify a suitable professional group. In practice, they would seek advice on patients' needs from dietitians (46%), clinicians (21%), both (16%), nurses (1%) or textbooks (1%). Hospital dietitians were perceived by 75% as providing an integrated advisory service to the clinicians with particular emphasis on individual patient needs. The remainder limited the dietitian to administering diabetic and weight-reducing diets (8%) or did not know (17%). Over half (52%) did not know of the existence of community dietitians whereas the others recognized their role in preventive education.

This survey, therefore, shows that a group of medical students were keen to learn nutrition and felt that their teaching was inadequate. The lack of practical teaching in nutrition as an integrated part of the clinical management of patients was highlighted: is this a new role for dietitians?

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**Some long-term metabolic effects of primary tumour removal in patients with or without metastases.** By D. T. HANSELL, J. W. L. DAVIES and H. J. G. BURNS, *University Department of Surgery, Glasgow Royal Infirmary, Glasgow G31 2ER*

It has been suggested that resting energy expenditure (REE) is increased in tumour-bearing patients, is greater still when there are metastases, and can be reduced by surgical removal of the primary tumour (Arbeit *et al.* 1984). In a continuing study of REE in patients with colorectal cancer, fourteen patients have been restudied 3–11 months after surgery at which time six were apparently free of tumour and eight had proven metastatic liver disease.

REE and respiratory quotient (RQ) were measured following an overnight fast using a closed canopy indirect calorimeter. Lean body mass (LBM) was derived from measurements of total body water using a tritium dilution technique. Preoperatively there were no significant differences between the groups with respect to age, weight, LBM, RQ or REE (whether expressed in kJ (kcal)/kg body-weight per d, kJ (kcal)/kg body-weight<sup>0.75</sup> per d or kJ (kcal)/kg LBM per d). The changes in body-weight and LBM recorded at follow-up are shown below.

	Tumour-free (n 6)	Metastases (n 8)	Statistical significance: P<
Δ Body-weight (kg)	+4.6 (58.8 → 63.4)	-3.2 (63.8 → 60.6)	0.005
Δ LBM (kg)	+2.7 (44.8 → 47.5)	-0.7 (47.8 → 47.0)	NS

NS, not significant.

Despite significant changes in body-weight, there was no significant difference in REE and RQ between the tumour-free patients and those with metastases. In the latter group, however, the follow-up RQ was significantly greater than the preoperative value.

	Tumour-free (n 6)				Metastases (n 8)			
	Preoperation		Follow-up		Preoperation		Follow-up	
	Mean	SEM	Mean	SEM	Mean	SEM	Mean	SEM
kJ/kg body-wt per d	96.7	5.9	96.7	6.7	96.7	3.4	106.7	12.1
kcal/kg body-wt per d	23.1	1.4	23.1	1.6	23.1	0.8	25.2	2.9
kJ/kg body-wt <sup>0.75</sup> per d	268.6	13.0	272.0	18.0	272.0	8.8	282.4	13.0
kcal/kg body-wt <sup>0.75</sup> per d	64.2	3.1	65.0	4.3	65.0	2.1	67.5	3.1
kJ/kg LBM per d	131.4	9.6	134.7	13.0	123.4	5.9	129.7	8.8
kcal/kg LBM per d	31.4	2.3	32.2	3.1	29.5	1.4	31.0	2.1
RQ	0.741	0.026	0.839	0.069	0.703	0.046	0.810*	0.021

Significantly different metastases preoperative value (Mann-Whitney U test): \*P<0.05.

In this continuing study, neither surgical removal of the primary tumour nor progression of the disease induced changes in REE.

Arbeit, J. M., Lees, D. E., Corsey, R. & Brennan, M. F. (1984). *Annals of Surgery* **199**, 292–298.

**Substrate oxidation in weight-stable and weight-losing cancer patients.**

By D. T. HANSELL<sup>1</sup>, J. W. L. DAVIES<sup>1</sup>, A. SHENKIN<sup>2</sup> and H. J. G. BURNS<sup>1</sup>,  
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Cancer patients who have lost more than 10% of their body-weight appear to have a higher resting energy expenditure (REE) than weight-stable cancer patients (Lindmark *et al.* 1984; Hansell *et al.* 1985). However, the increase in REE does not invariably seem great enough to account for all the weight loss.

In an effort to determine the metabolic basis of cancer-associated weight loss, substrate utilization was calculated from preoperative measurements of oxygen consumption, carbon dioxide production and urinary nitrogen excretion (Frayn, 1983) in twenty-four weight-stable and thirteen weight-losing patients with colorectal or gastric cancer. The weight-losing patients had each lost more than 10% of their pre-illness body-weight. REE was measured following an overnight fast using a closed-canopy indirect calorimeter. Lean body mass (LBM) was derived from measurements of total body water using a tritium dilution technique.

	Weight-stable		Weight-losing		Statistical significance†: P<
	Mean	SEM	Mean	SEM	
Age (years)	70.4	1.6	66.8	2.8	NS
Body-wt (kg)	66.1	2.7	52.4	3.1	0.005
Weight loss (kg)	0		12.1	1.8	0.001
Weight loss/month (kg)	0		3.5	0.6	0.001
LBM (kg)	52.2	2.3	43.8	2.3	0.01
Urinary N (g/d)	5.6	0.8	4.0	0.5	NS
REE (kJ/kg LBM per d)	119	3.3	128	3.3	0.05
(kcal/kg LBM per d)	28.5	0.8	30.6	0.8	0.05
Respiratory quotient	0.727	0.01	0.732	0.02	NS
Heat production from:					
Protein (%)	9.7	1.3	7.3	0.8	NS
Fat (%)	79.8	3.2	75.8	5.1	NS
Carbohydrate (%)	10.5	2.7	16.9	5.3	NS

†Mann-Whitney U test. NS, not significant.

There were no significant differences in substrate oxidation or respiratory quotient between the groups. The increased REE in the weight-losing cancer patients of 8.8 kJ (2.1 kcal)/kg LBM per d would amount to 11 544 kJ (2759 kcal)/month. Using the total heat productions derived from protein, fat and carbohydrate shown in the Table, this increased REE was subdivided into 841 kJ (201 kcal) from protein, 8749 kJ (2091 kcal) from fat and 1954 kJ (467 kcal) from carbohydrate, which in turn amounts to a loss of 201 g muscle, 232 g fat and 117 g carbohydrate and a monthly weight loss of 0.55 kg. As the mean monthly weight loss of the weight-losing cancer patients was 3.5 kg, the increased REE contributed little to their weight loss.

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**Whole-body protein synthesis and energy balance in surgical patients.** By H. C. WARD<sup>1</sup>, D. HALLIDAY<sup>2</sup>, and A. J. W. SIM<sup>1</sup>, <sup>1</sup>*Academic Surgical Unit, St Mary's Hospital, Norfolk Place, London W2* and <sup>2</sup>*Clinical Research Centre, Northwick Park Hospital, Harrow, Middlesex HA1 3UJ*

Protein synthesis is an energy-consuming process which may account for about 10% of resting energy expenditure (REE) in normal adults. A link between energy and protein metabolism has been shown by Gamble's (1946) work on ideal rations for castaways, in which glucose reduced nitrogen excretion in starvation, and by the protein-sparing effects of glycerol and triglycerides (Brennan *et al.* 1975). More recently, Sim *et al.* (1979) have shown that healthy subjects given glucose and amino acids had increased rates of whole-body protein synthesis (WBPS) compared with those given amino acids alone. We have now investigated the relation between rates of WBPS and energy balance (EB) in patients undergoing uncomplicated gastrointestinal resection without nutritional support.

Twelve patients, eight men and four women, mean (and SD) age 61 (14) years and mean weight 70 (10) kg, were studied before operation. Five of these, three men and two women, mean age 66 (16) years and mean weight 69 (13) kg were studied after operation as well. WBPS is calculated from whole-body N turnover and N excretion during a primed continuous infusion of [<sup>15</sup>N]glycine for 24 h (Sim *et al.* 1984). REE is estimated from oxygen consumption and carbon dioxide production measured by ventilated-hood indirect calorimetry. EB is obtained by subtraction of energy intake from REE. N turnover and REE were measured preoperatively and over the 3rd to 4th postoperative days. Non-protein energy intake was standardized at 1674 kJ/d by mouth preoperatively, starting 6 h before the study period, and as dextrose (50 g/l) given intravenously, postoperatively.

Preoperatively there was a correlation between rates of WBPS and EB ( $r_s$  0.666,  $P < 0.05$ ). In patients studied before and after operation, rates of WBPS fell as EB became more negative and WBPS correlated with EB ( $r_s$  0.776,  $P < 0.02$ ).

	n	WBPS (g/kg LBM per d)		EB (kJ/kg LBM per d)	
		Mean	SEM	Mean	SEM
Preoperative	12	4.01	0.33	-80.8	2.9
Preoperative	5	4.31	0.54	-74.5	1.7
Postoperative	5	2.76*	0.37	-83.7*	5.4

LBM, lean body mass.

Significantly different from  $n$  5 preoperative value (Wilcoxon matched pairs): \* $P < 0.05$ .

The fall in WBPS after surgery may be a response to inadequate energy provision as a means of energy conservation and as a result of diversion of whole-body protein breakdown to oxidation rather than protein synthesis.

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**Leucine and protein kinetics following surgery in man given varying branched-chain amino acid concentrations in a parenteral nutrition regimen.** By M. B. CLAGUE, A. P. BORZOTTA and IVAN D. A. JOHNSTON, *Department of Surgery, Newcastle General Hospital, Westgate Road, Newcastle upon Tyne NE4 6BE*

Increased loss of nitrogen following injury is the result of elevated muscle protein breakdown to provide amino acids for gluconeogenesis and visceral protein synthesis. Branched-chain amino acids (BCAA) may have a regulatory role in this process (Buse & Reid, 1975; Freund *et al.* 1978).

Leucine kinetics were assessed using a primed, constant-rate infusion of L-[1-<sup>14</sup>C]leucine (Clague *et al.* 1983) in twenty-two patients 2 or 3 d after elective abdominal surgery. Patients were randomized to receive a 24 h infusion of isoenergetic (109 kJ (26 kcal)/kg per d; 45% carbohydrate, 55% lipid), isonitrogenous (0.13 g N/kg per d) solutions with varying proportions of total amino acids provided as BCAA. A control group received only the energy source and no N.

*Leucine kinetics (mmol/kg per d) postoperatively in patients receiving diets with varying BCAA content*

% BCAA	n	Flux		Oxidation		Incorporation into protein		Release from protein		Balance	
		Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
0	6	1.43	0.25	0.20	0.08	1.23	0.22	1.43	0.25	-0.20	0.09
17	6	1.61	0.23	0.27	0.08	1.33	0.20	1.17	0.24	+0.16***	0.09
65	5	3.31***	0.15	0.78***	0.14	2.53***	0.27	1.54	0.17	+0.99***	0.15
85	5	3.98***	0.55	1.19***	0.27	2.79***	0.32	1.48	0.16	+1.31***	0.26

Significantly different compared with control value (Student's *t* test): \*\*\**P* < 0.001.

Increasing the BCAA content elevated leucine flux, oxidation and incorporation into protein with no change in the rate of release from protein (see Table). The resultant protein balance (8% leucine) correlated well with the BCAA content of the regimen ( $r = 0.975$ ,  $P < 0.001$ ).

This dose-dependent relation between protein metabolism and BCAA agrees with similar findings in critically ill patients (Cerra *et al.* 1983; Echenique *et al.* 1984) but the mechanism and target organ involved have yet to be elucidated in vivo.

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**Parenteral nutrition: a review of complications.** By J. MAIN, J. T. STEWART and C. R. PENNINGTON, *Medical Unit, King's Cross Hospital, Dundee*

The use of parenteral nutrition (PN) has been associated with major complications including sepsis. This retrospective study reviews our experience of such complications with reference to their incidence and future avoidance.

In the last 4 years, forty-five patients have received sixty-two courses of treatment (totalling 1238 d) as in-patients in a single medical unit and nine patients have received fifteen courses of home parenteral nutrition (3285 d). For the in-patients, fifty courses of central-line feeding and twelve courses of peripheral-line feeding were prescribed. Most patients required PN for the management of inflammatory bowel disease. Other indications included vascular disease of the bowel and perioperative support during major surgery.

A strict catheter protocol was employed with special emphasis on aseptic technique supervised by non-specialist nurses who had undergone a short training course. Prospective home patients were given training as in-patients with particular reference to catheter care, infusion pumps and the diagnosis and management of potential problems. All home patients and many in-patients received cyclical treatment.

Major complications included sepsis, catheter occlusion and venous occlusion. Catheter-related sepsis (septicaemia arising from the catheter) occurred in one in-patient and one out-patient (on three occasions). In each case the infections resolved following catheter removal and antibiotic prescription. Exit-site infection defined as reddening of the exit site without constitutional symptoms or bacteraemia occurred in one in-patient and two out-patients. Resolution occurred with topical betadine and a short course of antibiotic. Aseptic catheter occlusion was associated with the use of PN bags containing lipid; six catheters blocked after 70–402 (mean 206) d. Three patients suffered from superior vena caval thrombosis and one patient from subclavian thrombosis, two episodes occurred soon after catheter insertion and two patients had previously undergone splenectomy. The catheter was left *in situ* and resolution occurred after streptokinase (one patient) or heparin (three patients) administration. Deranged liver function tests occurred in some patients when dextrose was used as the single energy source.

We conclude that home and hospital PN can be safely conducted without the use of additional staff or specialized units. Sepsis can be avoided by the use of careful catheter protocols, venous occlusion may be avoided by attention to risk factors and catheter occlusion may be prevented by avoiding '3 in 1' mixes for long-term feeding.

**Home parenteral nutrition: a cost-effective evaluation.** By J. T. STEWART, C. R. PENNINGTON, J. MAIN and S. CROWE, *Medical Unit, King's Cross Hospital, Dundee* and J. RICHARDS, *Pharmacy, Ninewells Hospital, Dundee* and R. PRINGLE, *Division of Surgery, Ninewells Hospital, Dundee*

Developments in parenteral nutrition (PN), including the use of 3-litre bags, improved catheters and catheter care protocols, and knowledge of nutrient requirements, have facilitated long-term PN and ultimately home parenteral nutrition (HPN). HPN was first practiced in the UK in 1977 and in Scotland in 1980. We report our experiences with a HPN service over the last 4 years.

Thirteen patients were considered for treatment, one died of an unrelated disease and three were rejected on the grounds of renal failure, epilepsy and age. Nine patients received fifteen courses amounting to a total of 3285 d of treatment with courses of 1 month to more than 2 years duration. Seven patients suffered from Crohn's disease and indications for treatment included the short-bowel syndrome, enterocutaneous fistulae, growth retardation and multiple intestinal strictures.

Cyclical PN was employed, all nutrients including lipid were supplied in single 3-litre bags for nocturnal infusion, and a heparin lock was applied during the day. The nutrient solutions were compounded in the hospital pharmacy, delivered daily and used within 48 h of manufacture. Patients also received weekly supplies of items such as dressing packs and antiseptic solutions necessary for catheter care. A 2 week training programme on the management of PN in a single unit by certificated but non-specialist nurses preceded discharge from hospital. Particular emphasis was placed on catheter-care techniques, infusion pumps and the diagnosis and management of problems.

Treatment has been effective in all patients. Two patients with permanent intestinal failure have been maintained at home, growth and development have occurred in two patients, and enterocutaneous fistulae closed in a further three. Four patients worked while receiving treatment, two performed normal home duties and only one patient required substantial assistance with catheter techniques. Only one patient has suffered from catheter-related sepsis (on three occasions); five catheters became occluded after 70–402 (mean 210) d of treatment with lipid-containing bags. Single episodes of catheter breakage, catheter migration and glucose intolerance were experienced but there were no other complications.

The average cost of compounding lipid- and non-lipid-containing bags was £75 and £64 respectively, including nutrients, labour and accessories. The daily cost of materials for the two catheter procedures was £5 and there was an additional transport cost. No additional staff were required.

We believe HPN is safe and the cost is justified by an improved quality of life, reduced hospital stay and reduced expenditure on social services.

**The effects of postoperative metabolic support on lipolytic rates in patients undergoing elective abdominal surgery.** By J. BROOM<sup>1</sup>, I. E. BRACKENRIDGE<sup>2</sup>, E. SIMPSON<sup>1</sup>, J. D. B. MILLER<sup>1</sup> and I. MORISON<sup>3</sup>, <sup>1</sup>*Surgical Metabolic Unit, Department of Surgery;* <sup>2</sup>*Department of Therapeutics and Clinical Pharmacology* and <sup>3</sup>*Department of Pharmacy, Aberdeen Royal Infirmary, Foresterhill, Aberdeen AB9 2ZD*

The metabolic response to trauma is associated with mobilization of energy substrates including fat or fat-derived substrates. This lipolytic response is inhibited by the administration of dextrose-containing solutions (Blackburn *et al.* 1973; Swaminatham *et al.* 1980). Recently, in vivo lipolysis rates have been determined by extrapolation from the measurement of glycerol turnover rates in vivo using stepwise glycerol infusions (Carpentier *et al.* 1979; Broom *et al.* 1985).

Glycerol turnover rates were determined in two groups of patients ( $n_4$ ) undergoing elective abdominal surgery. Group 1 received 2 litres dextrose (25 g/l) – saline (9 g sodium chloride/l) postoperatively, whilst group 2 received the same volume of intravenous fluid but containing 1 litre isotonic amino acids (Perifusin) and no dextrose. Glycerol turnover rates were determined preoperatively and 24 and 72 h postoperation; plasma glucose and insulin concentrations were determined throughout.

In group 1, in all cases except one, the glycerol turnover was increased at 24 h but had fallen below preoperation values by 72 h. In group 2 the 24 h glycerol turnover was again increased but at 72 h had further increased over the preoperation values. The 72 h glycerol turnover rates in groups 1 and 2 were statistically significantly different ( $P < 0.05$ ), each patient being used as his own control. Plasma glucose concentration increased from fasting levels of 5.1 (SD 0.5) and 5.3 (SD 0.2) mmol/l in groups 1 and 2 respectively to 10.6 (SD 2.0) and 6.7 (SD 0.5) 24 h postoperation; at 72 h the levels had fallen in the Perifusin group (group 2) to fasting concentrations (5.4 (SD 0.5)) but remained elevated in the dextrose group (group 1) (7.8 (SD 0.5)). Plasma insulin concentrations were higher when plasma glucose concentrations were increased.

Thus, during a 3 d period of study, there were obvious differences in lipolytic rates between the two groups, with group 2 apparently switching to more of a fat-based fuel economy and lower circulating concentrations of glucose and insulin. This in vivo kinetic analysis of fat metabolism substantiates the claims that non-dextrose-containing regimens support endogenous fat breakdown post-operatively.

This work was supported by a grant from Merck Pharmaceuticals.

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**Some ways of improving the nutrition of patients who are receiving radiotherapy of the head or neck.** By HAZEL COUBROUGH and BERYL MCKINNON, *Dietetic Department, Aberdeen Royal Infirmary, Foresterhill, Aberdeen AB9 2ZB*

Most patients who are receiving radiotherapy are given little or no advice on food and fluid intake during the course of their treatment. Improved nutritional status has been shown to improve the response rate to radiation therapy and can normalize the immune response. A nutritional deficit is known to be a poor prognostic factor in cancer of the head and neck. There is thus a great need to identify and minimize the nutritional problems of such patients.

Obstacles to good nutrition were identified by interviewing patients who were undergoing courses of radiotherapy, and radiotherapists and senior nurses in radiotherapy wards and out-patient departments. A literature search confirmed our findings (Hegedus & Pelmam, 1975; Soukop & Calman, 1979; Vickers *et al.* 1981).

Adequate fluid intake is required to remove breakdown products of the destruction of cancer cells by radiation. Patient fatigue is increased if this clearance is inadequate and this in turn leads to reduced inclination to eat and drink. Inadequate energy intake leads to catabolism, tiredness and an unpleasant taste in the mouth. Radiation may reduce salivary flow and this presents great difficulties in dealing with dry foods and indicates a need for regular mouthwashes to reduce bacterial flora. The mouth or throat may be painful due to inflammation, stomatitis, candida or mouth ulceration. Hot and acid foods and drinks can cause acute pain and chewing and swallowing difficulties may be encountered due to the lesion, inflammation or pain. Thus the texture of foods need to be suited to the individual patient. Constipation may be a side affect of inadequate food or fluid intake, painkillers, diminished exercise or an inadequate intake of dietary fibre.

Assessment of the patient should be done before radiotherapy begins. This would include a diet history to indicate current food intake and any problems encountered. The patient who normally eats only when hungry may be considered to be at risk during the course of treatment. The radiographer, ward sister and radiotherapist should be aware of the potential problems and the strategies devised by the dietitian to combat these problems for in- and out-patients.

The few patient education booklets available from other centres were lengthy and contained information on every potential problem during treatment of cancer.

A series of patient information-leaflets have been produced on 'Radiotherapy of the mouth and throat', 'Mouth and throat problems', 'Altered taste sensation', 'Loss of appetite' and 'Constipation'. The Flesch formula was used to assess reading ease and a score of between 75 and 85 (fairly easy to very easy) attained. Leaflets can be given out by a designated member of the team according to individual problems and the dietitian should be called in to deal with difficult cases. Regular in-service education of nursing and radiotherapy staff will be required.

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**Experience of a nutrition group in the reduction of complications of central venous catheters.** By G. HADDOCK, JULIE BARR, AILEEN ROSS and O. J. GARDEN, *University Department of Surgery, Glasgow Royal Infirmary, Glasgow G3 1 2ER*

The provision of intravenous nutrition requires safe, long-term venous access. The 5-year experience of our surgical nutrition advisory group has been reviewed to determine the effect of changes in catheter insertion technique and in catheter management.

Between July 1979 and December 1984, 314 central venous catheters were inserted in 243 patients referred for nutritional support. Venous cannulation was performed by, or under the supervision of, clinicians experienced in the procedure. Using an aseptic technique, catheters were inserted for the first 12 months percutaneously into subclavian or internal jugular veins but thereafter by a cutdown technique into cephalic or external jugular veins. Twenty-seven different clinicians were involved in the insertion of these catheters. Catheters were managed by general-ward nursing staff with the exception of one surgical unit where, for the 6 month period to December 1984, catheter management was the responsibility of a designated nutrition nurse.

The insertion complications for each approach are listed below.

	n	Failed insertion		Malposition		Pneumothorax		Other n
		n	%	n	%	n	%	
Subclavian	52	4	8	1	2	3	6	2*
Internal jugular	16	0		1	6	0		0
Cephalic	204	4	2	6	3	0		0
External jugular	42	0		1	2	0		0

\*Cannula dislodged into right atrium necessitating operative removal (one) and hydro-mediastinum (one).

A comparison was made of catheter-related sepsis rates in the 6-month period to December 1983 in one surgical unit and the comparable period when a nutrition nurse was employed.

	Catheter-related sepsis								
	Catheter days			Suspected			Proven		
	n	Total	Range	n	%	per 100 d	n	%	per 100 d
No nutrition nurse	14	239	4-45	7	50	2.9	5	36	2.1
Nutrition nurse	21	310	4-41	2	10*	0.6	2	10	0.6

Fisher's Exact Test: \*P < 0.05.

Our experience demonstrates a reduction in insertion complications when a surgical cutdown technique is employed. Subsequent septic complications can also be substantially reduced by the appointment of a designated nutrition nurse.

**Hazards and benefits in a patient on long-term total parenteral nutrition.**

By J. S. de CAESTECKER<sup>1</sup>, A. SHENKIN<sup>2</sup>, G. S. FELL<sup>2</sup> and R. C. HEADING<sup>1</sup>,  
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We report our experience with a 42-year-old man with acquired idiopathic hypogammaglobulinaemia complicated by malabsorption, weight loss and incapacitating diarrhoea. He was managed over a 5-year period with daily total parenteral nutrition, mixed his own solutions and made his own additives at home: this enabled him to regain his normal weight and lead an entirely independent life in a remote part of the highland area. For technical reasons, trace element supplementation was intermittent. He developed biochemical evidence of copper depletion after treatment for 3 years (serum Cu 6.9 µmol/l, reference range (RR) 11–24 µmol/l), which was corrected by oral supplements of copper sulphate solution (40 µmol) on alternate days. At the same time, selenium deficiency was recognized biochemically by low-plasma Se levels (0.13 µmol/l, RR 0.8–1.6 µmol/l) and low erythrocyte glutathione peroxidase (*EC* 1.11.1.9) activity (3 units/g haemoglobin, RR 13–25 units/g haemoglobin). He had no clinical evidence of cardiomyopathy or skeletal muscle myopathy, but symptoms of exertional breathlessness and muscle cramps during infusions disappeared shortly after instituting oral Se supplements. Although plasma Se levels rose slightly to 0.35 µmol/l after 1 month, normal biochemical values of Se status were not achieved even after 6 months of oral Se supplements (3 µmol/d). The plasma Se level returned to normal within 2 months of starting intravenous supplements (0.8 µmol Se/d), although the erythrocyte glutathione peroxidase activity only rose 6 months after this was instituted. One month after starting oral Cu supplements, zinc deficiency was diagnosed by low plasma Zn levels (2.5 µmol/l; RR 12–18 µmol/l) after the appearance of a florid mucocutaneous eruption, which responded promptly to intravenous Zn supplements (200 µmol/d).

Four months later he developed biochemical evidence of cholestatic jaundice (alkaline phosphatase (*EC* 3.1.3.1) 1100 units/l, bilirubin 72 µmol/l) although he was asymptomatic. He had been receiving monthly intravenous infusions of immunoglobulin for a year, but virological studies were negative. Ultrasonography and endoscopic retrograde cholangio-pancreatogram were normal, but an isotopic liver scan suggested parenchymal liver disease. However, a liver biopsy revealed only a slight excess of mononuclear cells in the portal triads. Because the only recent alteration to his dietary regimen had been to increase his energy intake by infusion of fat emulsion daily rather than twice a week, lipid infusions were reduced to once a week and over the next 6 months his liver function tests improved. When last tested, his trace element levels and polyunsaturated fat profile were normal.

This case illustrates how, with monitoring and appropriate micronutrient supplementation, a patient living in a remote area may be managed successfully with total parenteral nutrition and may lead an active independent life.

**Parenteral nutrition in the management of short-bowel syndrome.** By  
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Short-bowel syndrome, characterized by diarrhoea, steatorrhoea, malnutrition and weight loss, follows excision of more than 70% of the small intestine. Although long-term survival on an oral diet with as little as 150 mm of small bowel has been reported, the majority of patients with short-bowel syndrome require parenteral nutrition either as a temporary measure until small-bowel adaptation develops or permanently if insufficient functioning small-bowel remains.

Between 1978 and 1984, twelve patients with short-bowel syndrome were referred to our unit for total parenteral nutrition (TPN). Four of the patients had undergone multiple small-bowel resections for Crohn's disease and were malnourished. Three of the four patients, who were non-oedematous, were between 11 and 24 kg below their ideal body-weight and had plasma albumin concentrations between 27 and 41 g/l. The fourth patient, who was oedematous, had a protein-losing nephropathy due to amyloid disease and a plasma albumin concentration of 19 g/l. The remaining eight patients had short-bowel syndrome following massive small-bowel resections for mesenteric infarctions. At the time of referral, the weights of these eight patients ranged from 36 to 79 kg and their plasma albumin ranged from 22 to 36 g/l.

Five patients were able to maintain their nutritional status by oral means after 25–120 d TPN. At the end of the TPN course, the mean weight of these five patients had decreased by 6.30 kg (not significant) and the mean plasma albumin had increased by 8.00 g/l ( $P < 0.0005$ ). Four patients did not adapt their small-bowel function sufficiently and required home parenteral nutrition after 28–150 d of in-patient TPN; during this period they showed no significant changes in their mean body-weight or mean plasma albumin concentration.

There were eleven episodes of catheter-related sepsis with eight of the episodes occurring in two patients; one of these died following one such episode. The TPN was generally well-tolerated and there were no major metabolic disturbances. Three patients died of causes not related to their TPN; two of chronic intra-abdominal sepsis and one of a cerebral infarction.

Parenteral nutrition thus provided an effective and safe method of nutritional support during the period of adaptation in the majority of patients with short-bowel syndrome and can be used on a long-term basis in those patients in whom adaptation does not occur.

**The effect of increased dietary fibre intake in patients with chronic renal failure.** By SHEILA I. MCKENZIE, *Department of Applied and Life Sciences, The Queen's College, Glasgow*, and I. S. HENDERSON, *Renal Unit, Glasgow Royal Infirmary, Glasgow G3 7ER*

Traditionally, chronic renal failure (CRF) patients are treated with a diet which is both low in protein and fibre and high in fat and refined carbohydrate. This reduces the accumulation of nitrogenous waste-products whilst maintaining an adequate energy intake (Dickerson & Lee, 1978). There is a known incidence of cardiovascular and intestinal problems in CRF patients which is possibly related to their present dietary management. The new dietary recommendations (National Advisory Committee on Nutrition Education, 1983), designed to reduce these problems, are not being fully prescribed for these patients due to their adverse effects on some serum indices, e.g. potassium. We therefore investigated the effect of changing the traditional dietary treatment of CRF patients to include a higher fibre intake. Sixteen patients out of an anticipated thirty have now completed the trial which included a 6 week high-fibre period and a 9 week post-trial period.

The results for four patients (two continuous ambulatory peritoneal dialysis (patients 1 and 2) and two haemodialysis (patients 3 and 4)) are shown.

*Daily dietary intake*

Patient no.	Fibre (g)			Potassium (mmol)			Protein (g)			Energy (MJ)		
	a	b	c	a	b	c	a	b	c	a	b	c
1	13	27	9	42	55	37	41	55	36	3.9	4.7	3.5
2	6	19	18	21	43	50	29	45	53	3.0	4.8	6.5
3	10	36	11	45	79	43	54	60	55	6.9	6.6	5.9
4	13	20	17	61	66	72	46	49	52	7.7	6.0	7.5

*Serum biochemistry and body-weight*

Patient no.	Haemoglobin (g/l)			Potassium (mmol/l)			Urea (mmol/l)			Body-wt (kg)		
	a	b	c	a	b	c	a	b	c	a	b	c
1	101	98	97	3.7	3.8	4.4	27.7	26.7	27.9	76.3	76.5	78.2
2	96	99	94	5.2	5.5	5.2	17.5	18.8	18.8	88.1	89.7	89.4
3	73	77	79	5.2	5.5	4.7	38.3	29.2	32.6	51.1	51.1	52.0
4	71	73	70	5.4	4.8	5.2	25.2	25.9	22.6	49.9	49.7	49.3

a, Pre-diet period; b, high-fibre diet; c, post-diet period.

No adverse effects were detected on the high-fibre diet; patient attitude was encouraging and possible beneficial effects on serum lipids are being studied.

We acknowledge the support of Alison Turner, The Queen's College, Glasgow, and the Department of Nutrition and Dietetics, Glasgow Royal Infirmary.

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**A method for indirect study of neonatal gut flora?** By S. J. ROSE and A. WHITE, *Departments of Paediatrics and Bacteriology, Raigmore Hospital, Inverness IV2 3UJ*, and N. MATHIESON, *Wolfson Gastrointestinal Laboratory, Western General Hospital, Edinburgh EH4 2XU*

Gaseous end-products of carbohydrate metabolism by gastrointestinal anaerobic bacteria include volatile fatty acids (VFA), carbon dioxide, hydrogen and methane. Hydrogen is not produced by mammalian cells, so bacterial metabolism of sugars has allowed the study of small intestinal transit time, small intestinal bacterial colonization, disaccharidase deficiency and bacterial activity in the gut. Newborn infants have a relative lactose intolerance allowing increased hydrogen production by lactose-fermenting coliforms, which have also been implicated in the aetiology of infantile gastroenteritis, a partially diet-dependent disease. It has been claimed that changes in hydrogen excretion in breath correlate well (70-75) with changes in coliform count and hence the effect of diet on neonatal gut flora populations could be studied non-invasively.

Breath hydrogen excretion in adults demonstrates a diurnal variation; similar information is not available for infants but if such variation was shown, it would not allow correlation with a relatively static bacterial population.

Half-hourly, end-tidal air samples were collected for 9 h via a Rahn Otis sampler, from ten neonates given a feed containing 73 g lactose/l every 3 h. The infants were 34-36 weeks old, by which age lactase (*EC* 3.2.1.23) is present in the gut. Hydrogen was analysed using a gas chromatograph with a Kathometer detector.

All infants except one excreted higher levels of hydrogen than adults (>10 ppm); the highest level was 88 ppm. There was considerable individual variation with up to a fivefold change during the study period. There was, however, no reproducible pattern of excretion between infants, although most demonstrated a rise after feeding. Because of this variability a standard time was chosen, 1 h before the midday feed, to take breath and faecal samples from a further twenty infants. Total anaerobic, coliform and *Eschericia coli* numbers were counted. Further samples were taken 1 week later. There was no correlation between breath hydrogen and total anaerobic, coliform or *E. coli* numbers, nor between changes in the above indices.

Breath hydrogen excretion in neonatal infants varies considerably during the day and from infant to infant. Unlike adult excretion, no reproducible pattern was recognizable. No correlation was found between changes in single-breath hydrogen estimations and coliform count, suggesting that the study of breath hydrogen is not an acceptable method of quantifying gut flora populations.

**Effects of dietary fat concentration and saturation on the catabolic response of protein metabolism to *Escherichia coli* endotoxin.** By J. WAN<sup>1</sup>, R. F. GRIMBLE<sup>1</sup> and M. GORE<sup>2</sup>, *Departments of <sup>1</sup>Nutrition and <sup>2</sup>Biochemistry, Southampton University Medical School, Southampton SO9 3TU*

Interleukin 1 (IL 1) is released from macrophages during trauma and causes acute-phase protein synthesis, fever, depressed plasma zinc and tissue protein loss. Prostaglandin E<sub>2</sub> has been implicated in a variety of IL 1 actions (Kampschmidt, 1984). General immune system function is impaired by saturated fat (Santiago-Delpin & Szepsenwol, 1977). The present study examined the effect of diets high and low in fat, and rich and poor in linoleate content, on IL 1 effects produced by *E. coli* endotoxin.

Young, adult, female Wistar rats were given for 4 weeks diets (protein energy 20.5%) containing maize or coconut oils (30 and 200 g/kg diet), casein, cellulose powder, vitamins and minerals. The coconut-oil diet contained 10 g maize oil/kg to prevent essential fatty acid deficiency. On the 4th week, half received 40 and 20 µg *E. coli* endotoxin (lipopolysaccharide B) intraperitoneally at 3-d intervals. After 2 d, all animals were decapitated and the indices shown were measured (six animals/group). Non-injected and injected animals were pair-fed.

	Maize oil (g/kg diet)				Coconut oil (g/kg diet)			
	30		200		30		200	
	Control	<i>E. coli</i>	Control	<i>E. coli</i>	Control	<i>E. coli</i>	Control	<i>E. coli</i>
Liver total protein (g)	1.8	2.0**	1.8	2.2**	1.8	1.9	2.0	2.0
Protein (g/kg tissue):								
Muscle (thigh)	182	148***	183	142***	185	182	178	173
Skin (abdomen)	133	127*	141	132***	126	127	129	129
Femur	64	57**	58	55*	58	58	59	60
Pelt weight (g/kg body-wt)	180	161	168	154*	164	153	163	156
Serum Zn (µg/ml)	1.48	1.36	1.33	0.79	1.17	1.25	1.01	0.99
Antichymotrypsin activity (% increase)	—	223	—	60	—	98	—	63
Corticosterone (ng/ml)	450	520	278	858***	563	365	443	393
Muscle cathepsin B (OD units/mg protein)	1.08	1.09	0.94	0.99	0.67	0.67	0.63	0.60

Significantly different from control value, same diet (Student's *t* test): \**P* < 0.05, \*\**P* < 0.01, \*\*\**P* < 0.001. OD, optical density.

Chronic feeding of coconut oil is known to deplete the membrane phospholipid precursor of prostaglandins, arachidonate (Croft & Beilin, 1984). Prostaglandin production would therefore seem to be important in the responses to *E. coli* toxin since coconut oil abolished the responses, with the exception of raised serum antichymotrypsin activity. The responses were enhanced by the 200 g maize oil/kg diet which was rich in linoleate, the precursor of arachidonate. In particular, the elevation of corticosterone was enhanced and the depression of serum Zn promoted in injected rats given the maize-oil diet. Thus dietary fatty acid composition, rather than concentration, has the greater influence on IL 1 actions.

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Kampschmidt, R. F. (1984). *Journal of Leukocyte Biology* **36**, 341–355.

Santiago-Delpin, E. A. & Szepsenwol, J. (1977). *Journal of the National Cancer Institute*

**59**, 459–461.

**A clinical evaluation of a new, effective peripherally-administered parenteral nutrition regimen.** By D. T. HANSELL<sup>1</sup>, J. W. L. DAVIES<sup>1</sup>, H. J. G. BURNS<sup>1</sup>, O. J. GARDEN<sup>1</sup>, A. SHENKIN<sup>2</sup> and D. C. CARTER<sup>1</sup>, *University Departments of <sup>1</sup>Surgery and <sup>2</sup>Biochemistry, Glasgow Royal Infirmary, Glasgow G3 7ER*

An intravenous feeding regimen which could be administered by peripheral vein may have a place in the management of surgical patients. Such a solution (Vitrimix; Kabi Vitrum, France) has been assessed in twenty-three patients undergoing colorectal surgery for malignancy. Vitrimix consists of glucose, amino acids and fat and can be mixed in the hospital ward using a simple vacuum device. Patients were randomly selected to receive on the first four postoperative days one of the following regimens: (1) dextrose-saline: 2 litres dextrose (50 g/l) and 1 litre saline (9 g sodium chloride/l); (2) amino acids: 1.5 litres Vamin N diluted with 1.5 litres water; (3) Vitrimix: one bottle of Vitrimix consisted of 0.75 litres Vamin glucose mixed with 0.25 litres Intralipid (200 g/l), two bottles were administered daily together with 0.5 litres dextrose (50 g/l) and 0.5 litres NaCl (9 g/l).

N balance was measured on each of the four postoperative study days. Resting energy expenditure (REE) was measured using indirect calorimetry and lean body mass (LBM) was derived from measurements of total body water. Patient groups were similar in terms of age, sex, weight, extent of weight loss, LBM, serum proteins, preoperative N balance and REE.

There was no significant differences in postoperative REE between the groups. Cumulative N balance during the study period is shown in the Table.

	Dextrose-saline	Amino acids	Vitrimix
<i>n</i>	8	8	7
Nitrogen (g/d)	—	14.1	14.1
Non-protein energy:			
kJ/d	1590	—	7113
kcal/d	380	—	1700
Cumulative postoperative N balance (g/4 d)			
Mean	-27.3*	-14.3	+7.2†††
SEM	3.0	3.2	2.8

Significantly different from value for amino acids (Mann-Whitney U test): \* $P < 0.05$ .

Significantly different from value for Vitrimix (Mann-Whitney U test): ††† $P < 0.001$ .

Six episodes of mild phlebitis occurred in twenty-eight patient days in those receiving Vitrimix compared with two episodes during amino acid infusion and one episode during dextrose-saline infusion over 32 d. No other complications were noted. We conclude that Vitrimix is a safe, simple intravenous feeding mixture which produces positive N balance following colorectal surgery.

**Release of extractives from intravenous nutrition bags.** By G. DOWNIE, N. McRAE and I. G. WILL, *Department of Pharmacy, Aberdeen Royal Infirmary, Foresterhill, Aberdeen AB9 2ZD*

Jaeger & Rubin (1972) reported finding di-2-ethylhexyphthallate (DEHP) in the tissue of thirteen patients who had died after receiving transfusions from polyvinyl chloride (PVC) containers. Following the introduction of the 3-litre bag containing a large number of intravenous nutritional components, much attention is currently being focused with regard to combining a fat emulsion with the solution in this container in order to simplify administration. When this is carried out in a PVC container there is a strong possibility that the plasticizer will be leached into the mixture.

1 litre Vamin N, 1 litre dextrose (500 g/l) and 0.5 litres Intralipid (100 g/l) were mixed in a 3-litre PVC infusion bag. One sample was withdrawn immediately and others after storage for 1, 2, 3, 24 and 96 h. Each sample was extracted with diethylether and the resultant extracts were analysed using high performance liquid chromatography (column 5 mm×250 mm Partisil-10 ODS, eluant methanol-water (9:1, v/v), flow rate 1.5 ml/min; wavelength 254 nm). One main peak was observed which was identified as DEHP. This was quantified using trifluoperazine as the internal standard.

Quantities of DEHP (mg) in the 3-litre mixture after fixed times were 0.1 h, 7.7; 1 h, 11.2; 2 h, 17.3; 3 h, 17.5; 24 h, 17.6; 96 h, 24.4.

This experiment was repeated using Vamin N only and dextrose only but no DEHP was present in the extract. In addition, Intralipid was shown to contain no DEHP before addition to a PVC bag. It was therefore proved that DEHP is leached from PVC by a fat emulsion. This leaching started immediately and a plateau effect was present between 2 and 24 h.

Further work was carried out to ascertain the effect of surface area. A 3-litre PVC infusion bag was cut into the following sizes 0.02 m<sup>2</sup>, 0.04 m<sup>2</sup>, 0.06 m<sup>2</sup>, 0.85 m<sup>2</sup> and 0.12 m<sup>2</sup>. The pieces were soaked in 500 ml Intralipid (200 g/l) for 15 min (this length of time was chosen in order to avoid the 'plateau' effect). It was found that the quantity of DEHP leached from PVC by the fat emulsion was directly proportional to the surface area.

To replace a PVC 3-litre container with one made from ethylene vinyl acetate (EVA) reduces the amount of DEHP infused into the patient but does not eliminate it since most administration sets are manufactured from PVC. The quantity of DEHP leached from the administration set increases with decreasing flow rate, as the time the fat emulsion is in contact with the PVC increases as the flow rate decreases.

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