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PROCEEDINGS OF THE NUTRITION SOCIETY

ABSTRACTS OF COMMUNICATIONS

A Scientific Meeting was held at the Devonshire Park Centre, Eastbourne on Tuesday–Thursday, 5–7 December 1995, when the following papers were presented. The first seven papers constituted an interdisciplinary meeting with BAPEN.

All abstracts are prepared as camera-ready material by the authors.

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Nutrition screening of acute in-patients. By CAROLYN DAVISON and IRENE STABLES, *Nutrition Services, South Tyneside District Hospital, Harton Lane, South Shields, NE34 OPL*

Nutrition is a crucial factor in health and ill health, yet malnutrition has been highlighted as an unrecognized problem in hospital patients (Lennard-Jones, 1992). This finding, combined with increased demands on local dietetic services, initiated a 9-month nutrition screening audit project, conducted by a nurse seconded to the dietetic team. The study aimed to improve patient care by empowering nursing staff to be more proactive in effective nutritional assessment and risk management.

Nutritional standards were devised between dietetic and nurse managers. A preliminary audit was carried out on nine acute wards, examining current nursing practice of nutritional assessment, care planning, implementation and review. Staff education was undertaken to implement change and the audit was repeated to review any change in working practice. The criterion-based study was comparative in nature with a sample size of 180 nursing records in both audits.

The preliminary findings were poor : nutritional assessment lacked structure and consistency; 31% had weight recorded, 7% had height recorded, 0% had BMI recorded. Planning, implementation and review of nutritional care was also inadequate and well below the standards: only 38% of 'at risk' patients received nutritional support.

To address problem areas, a programme of staff education was undertaken, in conjunction with the introduction of an assessment tool and strategy of nutritional care. This aimed to effect change by raising nutrition awareness in trained nursing staff and to promote effective, research-based practice.

The comparative results showed that significant improvement had been achieved in clinical practice following the education programme. The outcomes demonstrated were :

(i) improved recording of nutritional assessment in nursing records: 81% had weight recorded, 77% had height recorded, 78% had BMI recorded;
(ii) significantly improved working practice in care planning, implementation and review: of the 'at risk' group, there was a 90% increase in patients receiving nutritional support;
(iii) a marked increase in the uptake of high-protein supplements and meals: usage of nutritional products had increased by more than 100%;
(iv) heightened nutrition awareness in nursing staff: feedback indicated an overall trend of nutrition becoming a key issue in patient care;
(v) more effective use of dietetic services: nursing staff are more proactive and autonomous in nutritional care.

The provision of a structured framework for practice, supported by education was shown to encourage more consistent action. The study has highlighted the merits of integrating professional groups, in this case nurses and dietitians to challenge and consolidate clinical practice. The positive outcomes have subsequently led to the development of an operational nutrition support team to further explore and progress the multidisciplinary approach to nutritional management.

Lennard-Jones, J.E. (1992). *A Positive Approach to Nutrition as Treatment*. London: The King's Fund Centre.

A comparison between oral and nasogastric nutritional supplements in malnourished patients.

By JANET P. McWHIRTER and CHRISTOPHER R. PENNINGTON. *Department of Clinical Pharmacology, Ninewells Hospital and Medical School, Dundee. DD1 9SY.*

Most hospital patients who are malnourished are not referred for nutritional support (McWhirter & Pennington, 1994). There is a common perception that malnutrition is an inevitable manifestation of illness, that oral supplements (OS) are not well accepted, or reduce the consumption of food, and that nasogastric feeding is poorly tolerated. The present study aimed to assess the efficacy of supplemental enteral feeding on the nutritional status of malnourished patients, to compare OS with overnight supplemental NG feeding, and to determine the effect of nutritional supplements on consumption of oral diet.

Patients malnourished on admission were randomized to one of three groups; control (C), OS or NG. All patients had access to hospital diet. Supplements were prescribed to meet estimated energy requirements. Nutritional status was recorded at the start and the end of the feeding period. The total nutritional intake of all patients and tolerance of the feeding method were recorded.

Eighty-six patients completed the study, (twenty-six C, thirty-five OS and twenty-five NG). The diagnoses, mean age, and nutritional status categories were similar in each group. All patients were supplemented for at least 7d. The mean length of feeding time was 8.9 (C), 9.7 (OS) and 11.8d (NG) (p=NS). More than 80% of energy requirements were achieved in 71% OS, 88% NG and only 4% C (p<0.001). The mean energy intake from food did not change significantly during the course of the study. Weight gain occurred in 64% of the supplemented patients while 73% of the controls lost weight with mean weight changes of +2.9% OS, +3.3% NG and -2.5% C (p<0.001). The mean energy intakes from food in the three groups were 4.58 (OS), 4.28 (NG) and 5.25 (C) MJ (p=NS). The overall energy intake of the supplemented groups was similar. Three patients had very low intake of oral diet, took little oral supplementation, and did not improve nutritionally. These patients may have benefited from nasogastric feeding. There was no difference in oral intake of hospital food suggesting that nutritional supplementation did not affect appetite and therefore had a positive effect on total nutritional intake. There were no documented complications of OS. Three complications of NG included one case of diarrhoea, one of bloating and one accidental removal of the tube.

Thus, we have found that without nutritional supplements, malnourished patients lose weight. Both methods of supplementation lead to weight gain. Neither method of supplementation significantly affects oral food intake, although NG feeding may be more effective than OS in patients who are profoundly anorexic.

J.P.McWhirter is supported by Clintec Nutrition Ltd.

McWhirter, J.P. & Pennington, C.R. (1994) *British Medical Journal* **308**, 945-948.

A prospective study of nutritional changes and of gastrostomy feeding in motor neurone disease.

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There has been very little systematic documentation of the natural history and of the development of nutritional problems of patients with motor neurone disease (MND), most of whom develop dysphagia at some stage. Where this leads to weight loss in excess of 10%, it might be expected to exacerbate the muscle weakness of the underlying disease. There has also been some disagreement over the proportion of patients with MND who are likely to benefit from percutaneous endoscopic gastrostomy (PEG) feeding.

Eighty four patients referred sequentially to the Neurology Department with MND were seen initially and followed up where possible by a dietician between 1 June 1989 and 31 December 1994, with review every 3 months. The presence of bulbar symptoms, energy intake (by 3 day diary) and weight change was recorded at each visit.

Natural history: Complete follow-up information from onset of symptoms to death was obtained on twenty-seven patients. Half had developed dysphagia by 650 days, half had lost 10% of remembered weight by 575 days and by 870 days, half had died.

Nutritional treatment: If oral supplements proved unsuccessful and the patient developed either (1) severe dysphagia or (2) loss of 10% remembered weight with mild to moderate dysphagia or (3) oral energy intake below 1.5 x estimated metabolic rate (by Schofield[1]) with mild to moderate dysphagia, then they were offered a PEG to provide a route for food, fluid and drugs. Sixty-six (78%) of the original patients fulfilled the criteria for a PEG, thirty-two accepted, thirty-four either refused or failed to receive one for other reasons. Of the thirty-two who received a PEG, two did not use it and four died during their admission for PEG insertion. Twenty-one patients benefited in either maintaining or gaining weight or increasing their energy intake above 1.5 x resting metabolic rate. The feed was usually administered by overnight infusion (pump) with additional boluses by day. The amount administered and the rate of delivery above 120 ml/h were limited by (a) the patient's sensation of reflux and (b) shortness of breath due to weak respiratory muscles and the increased demand for gas exchange associated with diet-induced thermogenesis.

In conclusion, approximately one quarter of patients with MND may benefit from PEG feeding. At worst, insertion can be hazardous. However, a PEG has a useful palliative role, improving quality of life by providing a route for food, fluid and drugs. At best it may prolong life in those patients where bulbar palsy is the main feature of their disease. Neurology departments benefit from the services of an experienced dietician in following-up the patients and supervising supplementary or PEG feeding when required. The natural history of the development of nutritional problems in this population has been defined.

[1] Schofield W.N. (1985) Human Nutrition, Clinical Nutrition 39 (Supp 1), 5-41.

A randomized comparison of percutaneous endoscopic gastrostomy feeding and nasogastric tube feeding following acute dysphagic stroke. By BERNARD NORTON[1], BRIAN McKAIG[2], STUART A. BOOTH[1], CHRISTOPHER B. GORNALL[1], RICHARD G. LONG[2] AND GEOFFREY K. T. HOLMES[1]. [1]*Derbyshire Royal Infirmary, Derby, DE1 2QY and* [2]*Nottingham City Hospital, Nottingham NG5 1PB.*

Most patients admitted with acute neurological dysphagia are fed via a nasogastric (NG) tube. Percutaneous endoscopic gastrostomy (PEG) feeding is a well-established alternative which has many potential advantages. The aim of the present study was to identify whether early insertion of PEG after acute dysphagic stroke is of greater benefit to patients.

Twenty-seven patients (eleven male, sixteen female, mean age 77 years) were randomized at 14 d to receive nutritional support via NG tube or PEG. Patients were monitored by weight, anthropometric measurements and blood indices. Residual disability was measured using the Barthel Index (grade 0 to 20). Patients were followed prospectively and treatment assessed on the basis of changes in the above indices together with mortality, length of hospital stay, and treatment failure rates.

Fourteen patients (seven male, seven female, mean age 76 years) received PEG feeding and thirteen patients (four male, nine female, mean age 79 years) received NG feeding. Survival at 6 weeks was significantly higher in the PEG group with two deaths (14%) compared with nine deaths (69%) in the NG group ($P < 0.02$). NG tubes were pulled out and resited in nine patients (mean, six NG tubes per patient, range 1-10) compared with no tube replacements in the PEG group ($P < 0.01$). Six patients from the PEG group were discharged within 6 weeks of the procedure compared with 0 from the NG group ($P < 0.05$). Those in the PEG group had fewer treatment failures (0 *v* 3) and showed a greater improvement in nutritional status at 6 weeks compared with the NG-fed group. The mean initial Barthel Index score for both groups was 0.5 with twenty-two patients (81%) scoring 0 i.e. total dependence for all nursing care. There were insufficient numbers to study long-term survivors in the NG group. In the PEG group, at 6 months, the mean score was 4.8 ($P < 0.05$). Seven patients (50%) showed minimal or no improvement whereas three (21%) showed a marked improvement (Barthel score increased from a mean of 0 to 9 indicating improved quality of life). This study suggests that early PEG feeding is superior to NG feeding in patients following acute dysphagic stroke.

Minimal enteral feeding promotes gallbladder contractility in neonates. By G. JAWAHEER[1], N.J. SHAW[1], D.A. LLOYD[2] and A. PIERRO[3], *[1]Fazakerley Hospital, Liverpool L9 7AL, [2]Alder Hey Children's Hospital, Liverpool L12 2AP and [3]Great Ormond Street Hospital for Children, London WC1N 1EH*

The gallbladder of infants receiving parenteral nutrition (PN) is larger than normal and does not contract (Jawaheer *et al.* 1995). This may explain some of the hepato-biliary complications of PN in infancy.

In the present study, we tested the hypothesis that impaired gallbladder contraction observed in infants on PN is due to lack of enteral stimulation rather than to PN itself.

The effects of minimal enteral feeding on gallbladder contractility were studied in eleven stable neonates receiving PN since birth. The median gestational age was 33.0 (range 26-38)weeks; the median postnatal age was 3.0 (range 2-7)d; the median weight was 1.4 (range 0.9-3.9)kg. Bolus enteral feeds (1 ml/kg) were started on day 1 of the study and increased to 2 ml/kg on day 2, 3 ml/kg on day 3 and 4 ml/kg on day 4, while PN remained constant. After day 4, PN was gradually withdrawn. The study ended when the infants were fully enterally fed for 48h. Gallbladder volume was measured by ultrasound every 15 min up to 1h to detect the maximum gallbladder contraction at seven consecutive stages, as shown in the Table.

Gallbladder volumes shown in the Table from day 1 onwards are preprandial volumes. Results are expressed as median and range.

Stage	Gallbladder volume (mm^3)	Gallbladder contraction (%)
PN only	1843.1 (706.2 - 3116.9)	0.0 (0.0 - 13.3)
PN + bolus enteral feeding		
Day 1	1790.2 (706.2 - 4276.1)	24.1** (13.7 - 37.5)
Day 2	842.3** (394.4 - 1431.5)	26.8** (3.6 - 49.6)
Day 3	650.9* (215.6 - 1773.0)	50.2* (18.8 - 66.2)
Day 4	543.9** (181.6 - 1612.7)	58.7** (31.2 - 69.3)
Enteral feeding only (Day 1)	166.9** (51.7 - 636.4)	60.8** (50.3 - 85.5)
Enteral feeding only (Day 2)	159.1** (57.6 - 340.6)	75.7* (43.0 - 82.8)

Median values were significantly different from PN only: * $p < 0.05$, ** $p < 0.01$ (Wilcoxon test).

In newborn infants receiving PN, a 1 ml/kg milk bolus caused a signifant contraction of the gallbladder. Increasing the bolus size led to an increase in the size of the contraction. After 2d of small milk boluses, there was a significant reduction in gallbladder size. In conclusion, minimal enteral feeding in infants receiving PN promotes motility of the extrahepatic biliary tree.

Jawaheer G., Pierro A., Lloyd D.A. & Shaw N.J., (1995). *Archives of Disease in Childhood* 72; F200-F202.

Nights of bright lights and noisy pumps: home parenteral feeding. By D. Carter, C.Wheatley, R. Martin, S. Foley, C. Porrett, J. Nightingale, A. Micklewright, G. McHattie, L. Paul and M. Lee. *LITRE Working Party, 41 Adversane Road, Worthing, BN14 7QJ.*

A total of 188 members of PINNT (Patients on Intravenous and Naso-gastric Nutrition Therapy) who were receiving parenteral nutrition were sent a postal questionnaire and 116 (62%) responded (twenty four were children). They were asked about their venous access device, pump, infusion stand, delivery service and holiday arrangements.

Ninety-seven (84%) received their parenteral nutrition via a Hickman type central line, twelve (10%) had an implanted port, fifteen (13%) did not know their catheter type. Of those with a central line, seventeen stated they would like to change to another type of catheter, compared with only one person with an implanted port. Fourteen (12%) were not informed of catheter choice. Twenty-one (18%) were not happy with the site of their catheter.

Most (*n*108; 93%) were using a stationary type of pump with only eight (7%) using a fully ambulatory infusion device.. The majority (*n*86; 74%) did not have their pump regularly serviced, although fifty-nine (51%) had, in the past, needed to have their pump repaired. Most felt that the pump was reliable (*n*96;83%), easy to use (*n*110; 95%) and had an effective alarm system (*n*109;94%).

Transportation of equipment was a problem in the home environment, only thirty-four (29%) considered their pump and only twenty-seven (24%) considered their infusion stand to be easy to move around. Twenty-nine (26%) said that they found the infusion stand easy to carry upstairs. Seventy-six (66%) said the pump liquid crystal display was very bright and fifty-nine (51%) were kept awake by this; fifty-three (46%) were kept awake by the noise of the pump; fifteen (13%) of these by both. Thus ninety-seven (84%) were kept awake by the pump lights and/or noise.

A home delivery service of parenteral products was used by 104 (90%) patients; of these 101 (87%) were delivered by a commercial company and fifteen (13%) were delivered by local services; 104 (90%) said their supplies were always on time, and ninety-two (79%) said supplies were always complete. Only forty-five (39%) had a clinical waste collection.

Although most (*n*91; 78%) had taken a holiday, seventy-seven (66%) were apprehensive about taking one. The main reasons for the apprehension were transportation of the feed and equipment (*n*36;31%) and in case of illness or dehydration (*n*12;10%). Despite this thirty-five (30%) had travelled outside the United Kingdom for their holiday.

Most patients on home parenteral nutrition are happy with their delivery service and equipment, however careful choice of pump and infusion stand may help to increase mobility and reduce the problems caused by excessive noise and light.

Micronutrient deficiency in a home parenteral nutrition programme. By G. FORBES, A.U. JAWHARI, L. FIELDING, S. MAGNAY, S. WOOD and A. FORBES, *Departments of Gastroenterology, Clinical Nutrition and Pharmacy, St Mark's Hospital, Watford Road, Harrow, HA1 3UJ*

Home parenteral nutrition (HPN) for intestinal failure requires attention to energy content of feeds, fluid and electrolyte balance, and micronutrient status. When peripheral blood estimations of vitamins and trace elements are abnormal, the clinical significance in relation to deficiency or toxicity states is often unclear. We sought to determine the incidence and nature of clinically relevant micronutrient deficiency in our current HPN programme.

As of January 1995, fifty patients (mean age 45.7 years) were receiving HPN and had been doing so for a mean of 64 (range 1-175) months. The underlying diagnosis was Crohn's disease in twenty-one, visceral neuromyopathy in seven, abdominal desmoid in five, radiation enteritis in four, primary intestinal ischaemia in four, and intestinal failure of miscellaneous origins in nine. The average daily non-nitrogenous energy value of intravenous feeds was 5146kJ. Supplemental vitamins (Multibionta, Merck) 2-3 ampoules/week, folate 15 mg weekly, vitamin B_{12} 1 mg 3-monthly, and trace elements (Zn 120 μmol, Cu 20 μmol, Mn 5 μmol, Mo 2 μmol, Se 800 nmol, I 1 μmol and F 50 μmol in each day's parenteral nutrition) were given routinely. Phytomenadione, 10 mg 2-monthly, in the absence of underlying thrombotic tendency, and cholecalciferol 3.75 mg 2-monthly when deficiency had previously been demonstrated, were also given. Review of the case records was performed in combination with a semi-structured assessment of each patient at a routine 2-monthly visit.

Recognized micronutrient deficiency had previously developed in sixteen patients whilst receiving HPN. Fe-deficiency anaemia (haemoglobin <90 g/l, or fall of >20 g/l, with low serum ferritin and/or low transferrin saturation) occurred in fourteen patients, and resolved with Fe supplementation, except in one patient who had persistent intestinal blood loss. In seven the anaemia was preceded by identifiable events (gastrointestinal haemorrhage (*n* 5), menorrhagia, sepsis). In two others, concomitant folate deficiency was present. Biotin deficiency was diagnosed clinically in two patients, as manifest by dry eyes, angular cheilitis, and hair loss resolving with biotin supplementation (not present in Multibionta). Vitamin A deficiency responsible for visual disturbance developed in one patient who was temporarily not receiving vitamin A because of a possible, but unconfirmed, adverse reaction.

In contrast, laboratory assessment of selected micronutrients in twenty-nine consecutive attenders revealed wide deviation from normal ranges. Concentrations of Zn, Cu, Se, and vitamin E were substantially below the quoted lower limits of normal (Prof A Shenkin, University of Liverpool, personal communication) in seven, twelve, six, and fourteen patients respectively. Even retrospectively it proved difficult to identify any clinical correlates. It is unknown whether deficiency of micronutrients in target tissues is accurately predicted in this clinical setting.

Practical difficulties with Fe administration and chronic bleeding contribute to the development of anaemia. With this exception, clinical evidence of micronutrient deficiency appears uncommon in HPN practice, despite strikingly abnormal laboratory assays in many patients. The early features of most micronutrient deficiency states are somewhat subjective; without knowledge of tissue concentrations it remains difficult to judge the extent to which circulatory micronutrient deficiency should lead to therapeutic action.

Comparison of constant infusion and flooding methods for measuring muscle protein synthesis: effect of conventional total parenteral nutrition. By I. TJADER[1], P. ESSEN[1], J. WERNERMAN[1], M.A. M[C]NURLAN[2], P.J. GARLICK[2], K. SMITH[3] and M.J. RENNIE[3], [1]*Department of Anaesthesiology, University Hospital, Huddinge, Sweden,* [2]*Department of Surgery, SUNY, Stony Brook, New York USA,* [3]*Department. of Anatomy & Physiology, University of Dundee, Dundee DD1 4HN.*

Constant infusion and flooding dose methods are commonly used to measure human tissue protein synthesis, but they produce significantly different values: the flooding dose gives postabsorptive muscle protein synthetic rates twice those obtained after constant infusion (Smith *et al.* 1992); also, little stimulation of muscle protein synthesis is detected in response to oral feeding or total parenteral nutrition (TPN) (M[C]Nurlan *et al.* 1993). We have investigated these differences by simultaneous application of each method in six healthy males (80.5 (SD 10.3) kg) who received a primed, constant infusion of either [^{13}C] leucine (1 mg/kg per h, *n*#3) or [^{13}C] valine (1.4 mg/kg per h, *n*#3) over 7.5 h. After 6 h, a flooding dose of either 0.05 g/kg [^{13}C] valine or [^{13}C] leucine was administered (*n*#3 for each). TPN (5.6 kJ/kg per h, 8.3 mg N/kg per h) was infused throughout. Plasma was sampled to measure the ^{13}C-labelling of leucine, valine and their ketoacids. Muscle was sampled after 45 min, then immediately before, and 90 min after, flooding for measurement of incorporation of [1-^{13}C]leucine and [1-^{13}C]valine into protein. From incorporation of constantly infused tracer and average ketoacid enrichment, preflood muscle protein synthesis rates were 0.091 (SD 0.02) % per h (Val) and 0.083 (SD 0.01) % per h (Leu); *v.* 0.045 (SD 0.02) % per h commonly observed in postabsorptive subjects. Flooding did not change the incorporation of constantly infused tracer giving rates of 0.095 (SD 0.03) % per h (Val, NS) and 0.087 (SD 0.01) % per h (Leu, NS). Rates calculated using the flooding amino acids were similar to preflood constant infusion values (0.093 (SD 0.01), Leu and 0.107 (SD 0.02), Val). These results show that, in comparison with postabsorptive values, muscle protein synthesis measured using the constant infusion method is apparently doubled during TPN, to values routinely obtained using the flooding dose. However, with TPN the stimulation of tracer incorporation seen in postabsorptive subjects consequent upon flooding is not observed, possibly because of the increased availability of amino acids. In summary: flooding may stimulate muscle protein synthesis maximally, preventing a further rise due to TPN; alternatively the constant infusion method underestimates postabsorptive muscle protein synthesis, or that process is unresponsive to nutrient availability. Which interpretation is correct cannot yet be stated categorically.

M[C]Nurlan, M.A., Essen, P., Milne, E., Vinnars, E., Garlick, P.J. & Wernerman, J. (1993). *British Journal of Nutrition* **69**, 117-126.

Smith, K., Barua, J.M., Watt, P.W., Scrimgeour, C.M. & Rennie, M.J. (1992). *American Journal of Physiology* **262**, E372-E376.

The flooding-dose effect on the incorporation of constantly infused tracer leucine into skeletal muscle: studies with phenylalanine, threonine and arginine. By K. SMITH, N. REYNOLDS, S. DOWNIE and M.J. RENNIE, *Department of Anatomy and Physiology University of Dundee Dundee DD1 4HN*

Previously we demonstrated increased incorporation of constantly infused stable-isotope-labelled tracer amino acids into both muscle (Smith *et al.* 1992*a*,*b*) and plasma albumin (Smith *et al.* 1994) during intercurrent administration of a flooding dose of both leucine and valine. Since such branched-chain amino acids have been reported to stimulate muscle protein synthesis, we decided to investigate the specificity of the flooding effect by examining the consequence of flooding with phenylalanine, threonine and arginine on the incorporation of constantly infused [1-^{13}C]leucine into anterior tibialis muscle protein. Fifteen healthy male volunteers (21 (SD 3.5) years, 72.4 (SD 3.5) kg), studied after an overnight fast, were given a primed (1 mg/kg body weight), constant infusion (1 mg/kg per h) of [1-^{13}C]leucine over 7.5 h. After 6 h subjects were given a flooding dose of unlabelled phenylalanine, threonine or arginine (0.05 g/kg, n # 5 in each group). Plasma samples were taken throughout the study for the measurement of amino acid concentration and ^{13}C- enrichment in both leucine and α-ketoisocaproate (α-KIC) (which was taken to represent the precursor pool for protein synthesis). Muscle was sampled (i) after 45 min, (ii) immediately before the flood and (iii) 90 min postflood for the measurement of [1-^{13}C]leucine incorporation into muscle protein. The rates of muscle protein synthesis during the preflood period, calculated from the incorporation of leucine tracer and the average plasma α-KIC enrichment, were 0.036 (SD 0.01) % per h (Phe), 0.039 (SD 0.004) % per h (Thr) and 0.040 (SD 0.007) % per h (Arg). During the administration of phenylalanine and threonine floods the calculated rate of muscle protein synthesis was significantly increased to 0.067 (SD 0.02) % per h (Phe, P<0.05) and 0.070 (SD 0.02) % per h (Thr, P<0.05), whereas synthesis remained unchanged (0.050 (SD 0.015) % per h, NS) with arginine. These results suggest that the stimulation of muscle protein synthesis by administration of a flooding dose is not confined to leucine or valine and may be a more general effect of the essential amino acids. The robustness of the flooding-dose method is further undermined by these findings.

Smith, K., Barua, J.M., Watt, P.W., Scrimgeour, C.M. & Rennie, M.J. (1992*a*). *American Journal of Physiology* **262**, E372-E376.

Smith, K., Downie, S., Barua, J.M., Watt, P.W., Scrimgeour, C.M. & Rennie, M.J. (1994). *American Journal of Physiology* **266**, E640-E644.

Smith, K., Essen, P., McNurlan, M.A., Rennie, M.J., Garlick, P.J. & Wernerman, J. (1992*b*). *Proceedings of the Nutrition Society* **51**, 109.

A comparison of methods for measuring changes in fat-free mass in patients with the acquired immune deficiency syndrome. By N.I.J. PATON[1], D.C. MACALLAN[1], S.A. JEBB[2], C. NOBLE[1], C. BALDWIN[2], M. PAZIANAS[1] and G.E. GRIFFIN[1], *[1]St. George's Hospital Medical School, Tooting, London SW17 0RE and [2]Dunn Clinical Nutrition Centre, Hills Road, Cambridge CB2 2DH*

There has been considerable recent research to develop strategies for preventing the weight loss associated with the acquired immune deficiency syndrome (AIDS) and in particular the depletion of fat-free mass (FFM), in view of its potential relationship to survival. Evaluation of nutritional support regimens or anabolic agents demands accurate and precise measurement of changes in FFM. There are numerous cross-sectional studies comparing methods for measuring absolute body composition, but few longitudinal studies comparing the ability of different methods to measure changes in body composition. Such data are particularly necessary in malnourished patients in whom alterations in hydration are likely to confound determination of body composition changes.

We performed serial body composition measurements in twenty-one male AIDS patients (mean age 37 years, weight 66.1 kg, BMI 20.7 kg/m^2, CD4+ lymphocyte count 44 cells/mm^3) to assess the agreement between methods for measuring a change in FFM. Changes in FFM were measured by two reference methods: (i) total body water (TBW) by deuterium dilution and (ii) dual-energy X-ray absorptiometry (DEXA), and by two bedside methods: (iii) bioelectrical impedance (BIA) and (iv) skinfold thickness (SF). There were sixty intervals (mean length 5 months; mean weight change 3.9 kg) when body composition change was measured by at least one method. Measurements obtained using the four techniques were compared by Pearson's correlation and by calculation of bias (the mean of the differences between measurements by two techniques) and error (the standard deviation of the differences).

Methods	Number of Comparisons	Correlation	Bias (kg)	Error (kg)
TBW - DEXA	15	0.45	-0.6	3.1
SF - DEXA	35	0.88	+0.3	1.7
SF - TBW	21	0.62	+0.5	3.1
BIA - DEXA	10	0.72	- 1.7	4.9
BIA - TBW	4	0.94	-0.65	2.6
BIA - SF	27	0.40	+1.3	4.2

Agreement between the two reference methods, TBW and DEXA, was poor with a large error. This is most likely to be attributable to error in the TBW method resulting from acute alterations in the hydration fraction of FFM during weight change. DEXA, being less affected by changes in hydration, appears to be the more appropriate reference method for measuring changes in FFM in patients with AIDS. Agreement between changes measured by SF and DEXA was good, with the lowest bias and error. The two methods rely on different assumptions and this increases the confidence that they may be accurate, although we do not have a "gold standard" with which to compare them. BIA, as with TBW, is also greatly influenced by changes in hydration and showed poor agreement with DEXA with large errors for individual patients. Of the two bedside methods, SF appears to be superior to BIA for detecting FFM changes. The findings described above will assist in the rational choice of methods for studies evaluating body composition change in malnourished patients.

Measurement of total energy expenditure in patients with human immunodeficiency virus infection using the bicarbonate-urea method. By N.I.J. PATON[1], M. ELIA[2], S.A. JEBB[2], G.JENNINGS[2], D.C. MACALLAN[1] and G.E. GRIFFIN[1], *[1]St. George's Hospital Medical School, Tooting, London SW17 0RE and [2]Dunn Clinical Nutrition Centre, Hills Road, Cambridge CB2 2DH*

The bicarbonate-urea method is a new technique for measuring total energy expenditure (TEE) in which [^{14}C]-bicarbonate is given by subcutaneous infusion and TEE calculated from the specific activity of CO_2 incorporated into urinary urea. The technique has been validated against whole-body calorimetry for periods of 1-4 d (Elia *et al.* 1995) but has not previously been used in free-living subjects. The aim of the present study was to use the technique in patients with human immunodeficiency virus (HIV) infection to measure the daily variation in TEE, the physical activity level (PAL) in comparison with that estimated by an activity diary, and to assess the practicability of using the technique in free-living conditions.

Measurements were made over two consecutive days (1 d in one subject) in ten male patients with HIV infection (mean age 33 years, weight 72 kg, height 1.8 m, BMI 22 kg/m^2, CD4+ lymphocyte count 30 cells/mm^3). The subjects were metabolically stable and not suffering from acute infections. Resting energy expenditure (REE), which was measured by the Datex (Deltatrac) metabolic monitor, was found to be 7.46 (range 5.41 - 8.43) MJ/d, 105(SD 6)% of the values predicted by the Schofield equations ($P<0.02$ by paired T test). TEE was 10.69 (range 6.31 - 12.59) MJ/d or 154 (range 118 - 199) kJ/d per kg body weight and had an intra-individual day-to-day variation of 6(SD 6)%. The measured PAL (TEE/REE) was 1.42 (range 1.17 - 1.63), higher than the diary estimate of 1.34 (range 1.15 - 1.69). Individual values obtained by the two methods were correlated (R 0.53, two-tailed P = 0.02) but the inter-method differences were substantial (0.09 (SD 0.16)). The subcutaneous infusion of bicarbonate did not cause a local inflammatory reaction, was well tolerated and apparently did not restrict normal daily activities.

This is the first time that the intra-individual day-to-day variation in TEE has been measured using a tracer method. In this small group of patients with advanced HIV infection the daily variability in TEE was smaller (6(SD 6)% of TEE) than that of a group of very young male adults (PAL 2.0) who were assessed using an activity diary and indirect calorimetry (12(SD 3)% of TEE; Edholm *et al.* 1995), but the difference is not statistically significant. The present study also suggests that the PAL of the patients was not high and was compatible with that expected of people leading a sedentary lifestyle (Department of Health, 1991).

Finally, we found the bicarbonate-urea method both practical and acceptable to free-living patients.

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The effect of inhibiting gluconeogenesis on protein synthesis in cachectic tumour-bearing rats.

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We have previously found that increased energy expenditure in tumour-bearing rats is associated with increased postprandial glycogenesis which can be suppressed by inhibiting gluconeogenesis (Matthews *et al.* 1991). Amino acids represent one possible source of gluconeogenic precursors, and we postulate that cachexia may be associated with the diversion of amino acids away from protein synthesis and into glycogenesis. We have therefore determined the effect on postprandial protein synthesis of acutely inhibiting gluconeogenesis with 3-mercaptopicolinic acid (MP), an inhibitor of phosphoenolpyruvate carboxykinase (*EC* 4.1.1.49). Sixteen male Fischer 344 rats bearing a transplantable Leydig cell tumour (TB), fourteen *ad libitum*-fed controls (AD) and fourteen pair-fed controls (PF) were fasted overnight, then tube-fed a 16 KJ liquid meal. Half the rats in each group were simultaneously given 45 mg MP enterally. One hour later the rats were injected intraperitoneally with a flooding dose of L-(4-^{3}H)-phenylalanine, and after 15 min they were killed and samples of liver and gastrocnemius muscle were taken for analysis of specific radioactivity of free and protein bound phenylalanine using the method of Garlick *et al.* (1980).

	AD	AD+MP	TB	TB+MP	PF	PF+MP	Pooled SE
Muscle protein synthesis (%/d)	12.4^b	12.5^b	10.6^a	9.3^a	10.9^a	10.5^a	0.8
Muscle RNA (mg/g protein)	7.4^b	8.0^b	6.0^a	6.3^a	6.8^a	7.0^a	0.2
Liver protein synthesis (%/d)	77.0	66.0	80.8	72.9	65.0	63.5	5.8
Liver RNA (mg/g protein)	47.4^a	51.6^a	57.2^b	57.4^b	48.5^a	45.0^a	1.7
^{3}H incorporation into glycogen (dpm/g liver)	2163^a	622^b	2393^a	425^b	476^b	457^b	357

^{a,b} Mean values not sharing a common superscript letter were significantly different, $P<0.05$

TB and PF rats consumed approximately 27% less food than the AD group over the 10 d before the experiment, but all rats were then given the same sized test meal. In TB rats the rate of protein synthesis and the RNA content in skeletal muscle were significantly lower than in AD controls, but not significantly different from the values in PF controls, suggesting that in this model of cancer cachexia reduced muscle protein synthesis is caused mainly by chronically low food intake. MP treatment had no significant effect on either variable in muscle in any of the groups. Protein synthesis rate in the liver tended to be higher in TB rats, but the difference did not reach statistical significance. On the other hand, RNA content, which is considered to be an indicator of the capacity for protein synthesis, was significantly higher in the livers of TB rats than in either control group. Again, MP treatment did not significantly affect either variable. However, MP treatment did significantly reduce the amount of ^{3}H incorporated into glycogen in the livers of both AD and TB groups, indicating that it had effectively suppressed gluconeogenesis. ^{3}H incorporation into glycogen was low in both groups of PF rats, as expected from our previous work (Emery *et al.* 1993). These data indicate that acute suppression of gluconeogenesis does not affect the rate of protein synthesis in the postprandial period, implying that increased gluconeogenesis is not the cause of decreased protein synthesis in this model of cancer cachexia.

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Lymphocyte function may influence the inflammatory and metabolic response to tumour necrosis factor and endotoxins in humans. By DAVID B. GOUGH[1], KENNETH C. FEARON[2] and DAVID C. CARTER[2], *Departments of Surgery, [1]University of Aberdeen, Aberdeen AB9 2ZD, and [2]Edinburgh University, Edinburgh EH3 9YW*

Lymphocyte function is frequently depressed in patients with cancer. In contrast, circulating levels of tumour necrosis factor (TNF), a substance produced predominantly by mononuclear cells and which is thought to be an important mediator of cancer cachexia andthe acute-phase response to endotoxins, are often increased in patients with cancer and endotoxaemia. However, neither the production of TNF nor the levels of circulating TNF have been correlated with factors associated with the cachectic or acute-phase response. We investigated whether the combination of increased peripheral blood mononuclear cell (PBMC) TNF production and reduced lymphocyte function (*in vitro* PBMC blastogenesis in response to phytohaemagglutin (PHA response)) expressed as an index, i.e. TNF/PHA, might relate to variables reflecting the extent of the acute-phase response, metabolic dysfunction and reduced survival in thirteen patients with metastatic colorectal cancer, and the relative metabolic stability, absence of an acute-phase response and prolonged survival of seven healthy volunteers.

PBMC PHA response was determined by estimating the incorporation of tritiated thymidine in PBMC cultured with PHA. Spontaneous and endotoxin (1.25 μg/ml) stimulated PBMC TNF production was assayed using a WEHI cell line bioassay. In addition, weight change over the previous six months as assessed by questionnaire and patient records, and survival from the day of study were documented for all subjects.

No patient survived longer than 649 d, all had lost weight (median 9%), and showed evidence of an acute-phase protein response (median C-reactive protein (CRP) and albumin were 54 mg/l and 31 g/l respectively). In volunteers minimal weight gain (<3%) was observed in three subjects, but serum albumin and CRP concentrations were within the normal range. Spontaneous median PBMC TNF production in patients (119, range 16-2100 pg/ml) was not significantly different from healthy volunteers (49, range 19-402 pg/ml), but PHA response (expressed as a percentage of the mean volunteer response) in patients (38, range 9-80%), was significantly less than in volunteers (97, range 60-154%, $P<0.005$).

Spontaneous PBMC TNF production failed to correlate (Spearman Correlation) with CRP, albumin, CRP/albumin, or weight change. The TNF/PHA index correlated with CRP (r 0.74, $P=0.0005$), albumin (r -0.7, $P=0.0005$), CRP/albumin (r 0.8, $P=0.0005$), weight loss (r 0.49, $P=0.01$), neutrophilia (r 0.52, $P=0.02$) and the increase in TNF production in response to endotoxin (r 0.63, $P=0.01$) in the whole group and with CRP/albumin (r 0.58, $P=0.038$) and reduced survival (r -0.55, $P=0.038$) in the patients.

These results suggest that lymphocyte reactivity may influence the activity of spontaneous PBMC TNF production, the extent of the inflammatory response in humans, and the sensitivity of PBMC to endotoxins and may provide insight into the variability of the metabolic response in humans with cancer. Furthermore the findings suggest that the activity of endotoxins and TNF in humans may be regulated by lymphocyte function.

Impairment of interleukin-2 production and increased spontaneous tumour necrosis factor production by peripheral blood mononuclear cells may facilitate an exaggerated response to circulating endotoxins in humans. By DAVID B. GOUGH[1], KENNETH C. FEARON[2] and DAVID C. CARTER[2], *Departments of Surgery, [1]University of Aberdeen, Aberdeen AB9 2ZD, and [2]Edinburgh University, Edinburgh EH3 9YW*

While endotoxaemia in humans is associated with the induction of an acute-phase response, levels of endotoxins do not appear to correlate with the extent of the acute-phase response or the survival of patients with critical illness. It has been suggested that substances such as tumour necrosis factor (TNF) secreted by immune cells may mediate the effects of endotoxins, and that sensitivity to both endotoxins and TNF may be increased in the cancer state. The variability in the sensitivity to both TNF and endotoxins may account for the lack of correlation between the clinical response and the levels of these substances in humans. We have begun to explore the hypothesis that lymphocyte function may modulate the sensitivity of humans to both TNF and endotoxins. The aim of the present study was to examine whether an index incorporating tests of lymphocyte reactivity and spontaneous mononuclear activity (peripheral blood mononuclear cell (PBMC) interleukin-2 (IL-2) production and basal PBMC TNF production), incorporated in an index, (TNF/IL-2), might reflect *in vivo* responses to endotoxins.

Blood was drawn on the same morning from a pool of five healthy volunteers and eight patients with metastatic colo-rectal cancer. *In vitro* spontaneous PBMC TNF production (WEHI cell line bioassay), PBMC IL-2 production (CTLL-2 cell line bioassay) in response to phytohaemagglutinin (PHA), serum C-reactive protein (CRP), albumin, percentage weight change over the previous 6 months, lean body mass index (LBMI) and BMI (calculated from indices of height and weight), and survival of patients with cancer were documented.

Significant levels of endotoxin were found in 4/5 volunteers (median 4, range 1-6.5 pg/ml) and 5/7 patients with cancer (median 18, range 2-27.5 pg/ml) and median spontaneous TNF production in these subjects was 44, (range 39-208) pg/ml (volunteers) and 121(range 16-267) pg/ml (patients). Neither the levels of endotoxin nor the amount of PBMC TNF production correlated with CRP, albumin, weight change, BMI, LBMI, or leucocyte count (WCC).

The index derived by TNF/IL-2 multiplied by the levels of circulating endotoxin in the nine subjects with evidence of endotoxaemia correlated with CRP (r 0.72, P=0.03), albumin (r -0.88, P=0.002), CRP/albumin (r 0.78, P=0.013), WCC (r 0.67, P=0.05), weight loss (r 0.88, P=0.01), BMI (r -0.88, P=0.001) and LBMI (r 0.77, P=0.016) despite considerable overlap in all of these variables between the patients and volunteers.

The clinical significance of endotoxaemia may relate to the degree of impairment of lymphocyte IL-2 production, the spontaneous production of TNF and the levels of circulating endotoxin. The correlations observed in this study may explain the lack of an inflammatory response in immunocompetent humans who exhibit endotoxaemia, and may provide insight into the variability of the cachectic and inflammatory response in endotoxaemic patients with cancer.

Survival of intensive care patients given glutamine-supplemented parenteral nutrition: a double-blind, randomized treatment study. By RICHARD D. GRIFFITHS, CHRISTINA JONES and T. E. ALLAN PALMER. *Intensive Care Research Group, Department of Medicine, University of Liverpool, Liverpool L69 3BX*

Low plasma and tissue levels of glutamine (Gln) in the critically ill suggest that demand may exceed endogenous supply (Palmer *et al.* 1994). A relative deficiency of glutamine could compromise recovery and result in a prolonged illness and an increase in late mortality (Griffiths *et al.* 1995). Our hypothesis was that this could be prevented by an exogenous glutamine provision during the early stages of critical illness. We report the effect of parenteral glutamine supplementation in those patients unable to tolerate nasogastric feeding who are also usually the most severely ill. Our previous follow-up experience showed that such severely ill patients had a 6-month mortality of 60%.

Eighty-four patients ranging in age from 22-89 (median 65) years and APACHE II score > 10 (range 11-34) who were admitted to a general intensive care unit (ICU) received either conventional total parenteral nutrition (CnTPN) or an isonitrogenous, isoenergetic feed supplemented with 25 g crystalline L-glutamine per 3-litre bag (GlnTPN) in a double-blind, block randomized treatment study.

Group comparisons	CnTPN (*n* 42)		GlnTPN (*n* 42)	
	Median	Range	Median	Range
Age (years)	64.5	22 - 81	65.5	22 - 89
M:F ratio	23:19	-	24:18	-
Admission APACHE II score	17	11 - 31	18	11 - 34
APACHE risk of death prediction	0.39	0.06 - 0.83	0.39	0.05 - 0.87
Admission TISS score	35.5	23 - 53	34	18 - 45
Admission nutritional score (mean, SD)	0.83	0.9	0.93	0.8
Actual KJ/d for day 1-5 TPN	6688	1931 - 10,216	6763	2395 - 11,972
Actual N g/d for day 1-5 TPN	13	7 - 20	12	6 - 20

APACHE II, acute physiology and chronic health evaluation II score; TISS, therapeutic intervention scoring system; Admission nutritional score: normal=0, malnourished =1, severely malnourished = 2.

Despite a typical broad spread of conditions there were no significant differences between the groups indicating a successful randomization. The amounts of nutrients received initially were similar.

Outcome at 6-months	CnTPN (*n* 42)				GlnTPN (*n* 42)			
	Lived, *n* 14		Died, *n* 28*		Lived, *n* 24		Died, *n* 18*	
	Median	Range	Median	Range	Median	Range	Median	Range
Total time of TPN (d)	6	2 - 31	6.5	2 - 91	7	2 - 43	4.5	1 - 18
Stay ICU and post ICU (d)	22.5	11 - 155	13.5'	4 - 106	37.5	7 - 207	8.5	3 - 23

*, Significantly different survival and mortality at 6-months, $P = 0.049$ (2-tail, Yates-corrected Chi^2).

', Significantly longer stay (late deaths) than GlnTPN (died). $P = 0.013$ (2-tail, Mann-Witney).

Mortality was significantly greater at 6-months following ICU admission for the CnTPN, 66.7% compared with GlnTPN, 42.9%. The pattern of early deaths was similar. With a number of the CnTPN deaths there was a significantly longer stay and increased late mortality. This would suggest that the addition of glutamine prevented similar late deaths in the GlnTPN group.

These findings support the hypothesis that a glutamine-containing TPN when used as treatment on a general ICU improves survival after severe illness.

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Effects of fish oil, olive oil and maize oil on the metabolic responses to turpentine-induced inflammation in the rat. By S.S.IQBAL[1], M.M.SH. DUWAIHY[2], R.A.AL-SHAGRAWI[3], and D. J. MILLWARD[4]. *[1]Department of Community Health Sciences, College of Applied Medical Sciences, [2]Department of Food and Nutrition, College of Agriculture, [3]Department of Nutrition, King Abdul Aziz University Hospital, King Saud University, P.O. Box 245 Riyadh 11411, Kingdom of Saudi Arabia, and [4] Centre for Nutrition and Food Safety, School of Biological Sciences, University of Surrey, Guildford GU2 5XH.*

Dietary fat has recently been shown to influence the metabolic responses to cytokine-induced and endotoxaemic models of inflammation. In the present study we have examined the influence of dietary fat on the metabolic responses to turpentine-induced inflammation (Wusteman *et al* 1990). Weanling rats were given 200 g/kg fat diets based on maize oil (MO), olive oil (OO), or fish oil (FO, 160g olive oil + 40g fish oil/kg) for 6 weeks, achieving a mean body weight of 211 g, before turpentine treatment. This involved three subcutaneous injections (2 ml/ kg BW) at 48 h intervals. Body weights and food intakes were recorded throughout the experiment. The rats were killed after an overnight fast 6 d after the first turpentine injection along with the respective pair-fed controls. Standard methods were used to estimate levels of glucose, glutamine, insulin, total protein, albumin and Zn in serum and RNA, total protein, glutathione and MDA concentrations in both liver and gastrocnemius muscle. Glutamine was also measured in muscle and zinc in liver. Liver tissue membranes were extracted and their fatty acid profile was analyzed by gas chromatography.

After 6 weeks on the diets membrane lipid fatty acid content, (g/100 g), reflected dietary intakes with higher C18:2n-6 in the MO (25) compared with OO (9.8) or FO (10.8), and higher C20:4*n*-6 in MO (20) and OO (21) compared with FO (13). Long-chain *n*-3 fatty acids were only present in the FO group, as C20:5n-3 (4), C22:5*n*-3 (1.4) and C22:6*n*-3 (7). In response to the turpentine, food intake fell immediately by an average of 40% with no difference between groups. This induced a similar growth inhibition and gradual body weight loss over the 6 d of 6% body weight which did not differ between groups and was similar in pair-fed (PF) control rats. The turpentine-treated rats exhibited in most cases similar metabolic responses regardless of the dietary fat source. Significant differences between the treated and PF controls ($P<0.05$), included enlarged livers (116% PF), increased hepatic protein synthesis as judged by the increased RNA:protein ratio (130% PF), increased hepatic Zn (130% PF), reduced serum albumin (70% PF), Zn (65% PF), glutamine (65% PF) and glucose (76% PF) with no change in plasma insulin levels. In skeletal muscle there was reduced total protein (85% PF) and free glutamine (75% PF). Somewhat surprisingly there was an increased muscle RNA concentration suggesting that in rats of this age and after this prolonged inflammatory insult, the catabolic response of skeletal muscle involved accelerated protein turnover.

Surprisingly, the fish oil did appear to ameliorate oxidative stress as judged by significantly lower, ($P<0.05$) increases in MDA concentrations compared with PF rats in both liver (120% *v* 145%, OO and 156% MO) and in muscle (113% *v* 125% OO and MO), and lesser reductions ($p<0.05$) in reduced glutathione (non-protein SH groups) compared with PF rats in both liver (77% *v* 58% OO and 52% MO) and muscle (70% *v* 63% OO and 61% MO).

It would appear, therefore, that in this rat model, increased dietary fish-oil intake at a level which is achievable in human diets and which is sufficient to alter membrane lipid profiles to an extent which could influence eicosanoid activity, does influence the metabolic response to inflammation, at least in terms of ameliorating the level of oxidative stress, although we have been unable to identify any other influences.

We thank Seven Seas Ltd for the Fish Oil.

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Dietary lipids affect the sensitivity of rat thymic lymphocytes to glucocorticoids. By P. YAQOOB and P.C. CALDER, *Department of Biochemistry, University of Oxford, South Parks Road, Oxford OX1 3QU*

Glucocorticoids inhibit many aspects of immune function, including T-cell proliferation, T-cell-dependent immunity and cytokine production. Anti-inflammatory and immunosuppressive treatments commonly involve the use of these steroids, which can have harsh and unwanted side-effects. Fish oils, which are rich in *n*-3 polyunsaturated fatty acids (PUFA), have been shown to suppress immune-cell functions (see review by Yaqoob & Calder, 1993). Given the problems associated with steroid treatment, there is considerable interest in the use of dietary intervention in clinical situations where immunosuppression is required and it has been suggested that fish-oil supplementation may reduce the requirement for steroids under these conditions (Hawthorne *et al.* 1992). However, little is known about the interactions between the two. In the present study, the effects of dietary lipids on the *ex vivo* sensitivity of rat thymic lymphocytes to glucocorticoids was investigated.

Rats were fed for 10 weeks on a low-fat diet (LF; 20 g/kg) or on high fat diets containing 200 g/kg of hydrogenated coconut oil (HCO), safflower-seed oil (SO) or menhaden (fish) oil (MO). Thymic lymphocytes were prepared and cultured with various concentrations of either hydrocortisone or dexamethasone, in the presence of 2.5 ml/l autologous serum and 5 μg/ml concanavalin A. Proliferation was assessed by incorporation of [^{3}H]thymidine over the final 18 h of a 66 h culture period. The data are expressed as the percentage inhibition of thymidine incorporation observed in the absence of added glucocorticoid and are means with their standard errors from five or six animals fed on each diet.

	% Inhibition of thymidine incorporation							
Diet...	LF		HCO		SO		MO	
Steroid (ng/ml)	Mean	SEM	Mean	SEM	Mean	SEM	Mean	SEM
Hydrocortisone								
1	15.9	6.3	7.3	2.3	12.6	4.6	16.9	5.3
10	18.7	8.6	31.1	6.5	23.6	7.4	36.6	1.6
50	45.6^a	5.2	56.0^a	6.5	55.2^a	5.4	82.7^b	7.9
100	44.6^b	2.2	63.0^a	5.6	61.3^a	6.8	83.8^c	5.3
1000	51.3^a	4.9	62.0^a	2.6	76.4^b	3.2	88.0^b	4.6
Dexamethasone								
1	20.2	4.1	30.3	5.3	29.6	3.2	25.8	5.3
10	45.4^a	7.5	49.0^a	3.8	69.6^b	3.4	75.7^b	3.8
50	64.8^b	6.2	71.8^{ab}	5.6	70.5^{ab}	3.1	82.5^a	4.6
100	67.1^b	7.9	71.2^{ab}	6.2	78.5^{ab}	2.5	85.7^a	3.0
1000	66.1^a	5.7	62.2^a	2.9	80.1^b	2.9	87.9^b	3.9

^{a,b,c} Mean values not sharing a common superscript letter were significantly different, $P<0.05$ (Student's *t* test).

The effect of dexamethasone on the proliferation of thymic lymphocytes from LF-, HCO- and SO-, but not MO-, fed rats was more potent than that of hydrocortisone. When compared with the LF diet, feeding the HCO diet did not affect the sensitivity of lymphocytes to either glucocorticoid, whereas feeding the SO diet did appear to increase the sensitivity of lymphocytes to the higher concentrations of both glucocorticoids. In general, lymphocytes from the MO-fed rats were significantly more sensitive to the inhibitory effects of both glucocorticoids than those from rats fed on each of the other diets.

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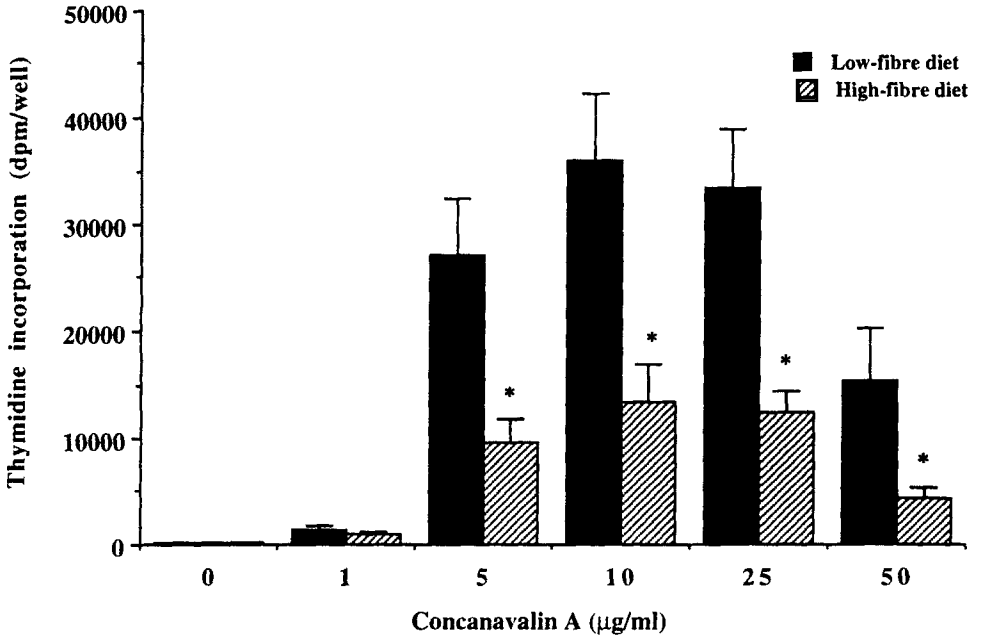
The effect of dietary fibre upon rat peripheral blood lymphocyte proliferation. By P.C. CALDER[1], C. FELIPPE[2], L.F.B.P. COSTA-ROSA[2] and R. CURI[2]. [1]*Department of Biochemistry, University of Oxford, South Parks Road, Oxford OX1 3QU and* [2]*Department of Physiology and Biophysics, University of Sao Paulo, Sao Paulo, Brazil*

Short-chain fatty acids (SCFA) inhibit phagocytic cell functions *in vitro* (see review by Brisseau & Rotstein, 1995). In addition, *in vitro* T-lymphocyte proliferation has been shown to be inhibited by acetate (Franklin *et al.* 1991), butyrate (Matsui *et al.* 1984; Eftimiadi *et al.* 1991; Franklin *et al.* 1991) and propionate (Curi *et al.* 1993). These observations suggest that conditions which increase the concentration of SCFA in the bloodstream might lead to suppressed activity of immunocompetent and inflammatory cells. One such condition is consumption of diets rich in fibre. There have been no investigations of the effect of dietary fibre upon lymphocyte functions. Therefore, the current study investigated the effect of feeding rats on a diet rich in fibre upon peripheral blood lymphocyte proliferation measured in whole-blood cultures.

Weanling male Wistar rats were fed for 8 weeks on either a low-fibre diet (Purina chow) or a high-fibre diet (Purina chow containing 300 g wheat bran/kg). After slaughter, blood was collected and diluted 10-fold in culture medium (Hepes-buffered RPMI containing 2-mM glutamine and antibiotics). Diluted blood (180 μl) was cultured with various concentrations of the T-cell mitogen, concanavalin A (20 μl); [^{3}H]thymidine incorporation was measured over the final 18 h of a 66 h culture period. Results are mean and standard error for five animals fed on each diet.



At concanavalin A concentrations of 5, 10, 25 and 50 μg/ml T-lymphocyte proliferation was significantly lower (Student's *t*-test; $P<0.02$ at least) in cultures of whole blood from animals fed on the high-fibre diet compared with those from animals fed on the low-fibre diet (see Figure). These findings suggest that SCFA arising from fermentation of dietary fibre may have systemic effects, including potent effects upon the functioning of cells of the immune system. As such, dietary fibre could be used as a nutritionally-based means of modulating cell-mediated immunity.

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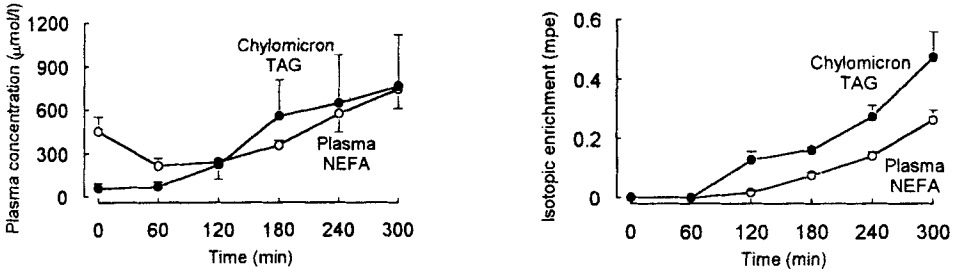
Rapid entry of dietary fatty acids into the plasma non-esterified fatty acid pool. By BARBARA A. FIELDING[1], KEITH N. FRAYN[1], DAVID HALLIDAY[2], PETER A BANNISTER[2], JOANNE CALLOW[1], and SOUNDARARAJAN VENKATESAN[2], *[1]Oxford Lipid Metabolism Group, Radcliffe Infirmary, Oxford OX2 6HE and [2]MRC Human Metabolism Research Group, St Mary's Hospital Medical School, London W2 1PG*

In the postabsorptive state non-esterified fatty acids (NEFA) arise almost entirely from hydrolysis of adipose tissue triacylglycerol (TAG), and the regulation of this process is reasonably well understood. However, humans in Western societies spend much of their time in a postprandial state. In this condition intracellular hydrolysis of TAG is suppressed. However, plasma NEFA may also arise from the action of lipoprotein lipase (*EC* 3.1.1.34, LPL) on circulating TAG. The extent to which this process contributes to the plasma NEFA pool has not been quantified, and the regulation of NEFA production by this route is little understood. Here we present initial studies aimed at tracing the movement of dietary fatty acids using a stable-isotope approach.

Four healthy subjects (two male), aged 22 - 47 years, BMI 19.2 - 29.9 kg/m^2, were studied after an overnight fast (evening meal fat free). Blood samples were taken from a venous cannula before and after the subjects ate a meal consisting of 282 g ice-cream (Rich Chocolate Fudge Brownie, J. Sainsbury plc) providing 45 g fat, of which 12% (by weight) of fatty acids were stearate. Into this had been homogenized 478 mg [$^2H_{35}$]-stearic acid (Cambridge Isotope Laboratories, Woburn, MA, USA). A chylomicron-rich fraction was separated by centrifugation and lipids extracted from this, from plasma and from a sample of the meal. Chylomicron-TAG, plasma NEFA and meal TAG fatty acids were methylated and separated by gas chromatography (GC). Isotopic enrichments were measured by GC-mass spectrometry (Finnigan Incos XL).



Chylomicron TAG and plasma NEFA concentrations changed as shown (Figure). Mean isotopic enrichment of stearate in the meal was 3.25 moles percent excess (mpe). Isotopic enrichments in chylomicron-TAG and plasma NEFA (Figure) rose with time but were always less than the enrichment in the meal. At 5 h the isotopic enrichment in plasma NEFA was 55% of that in chylomicron-TAG.

The large drop in enrichment from meal to chylomicron-TAG suggests incomplete or slow absorption of tracer; this is reinforced by the steady increase in chylomicron-stearate enrichment. The relationship between chylomicron-TAG and plasma NEFA enrichment is consistent with a precursor-product relationship, and suggests that towards the later part of the postprandial period a large proportion of plasma NEFA arose directly from chylomicron-TAG.

This methodology will make it possible to investigate the regulation of the entry of different dietary fatty acids into the plasma NEFA pool.

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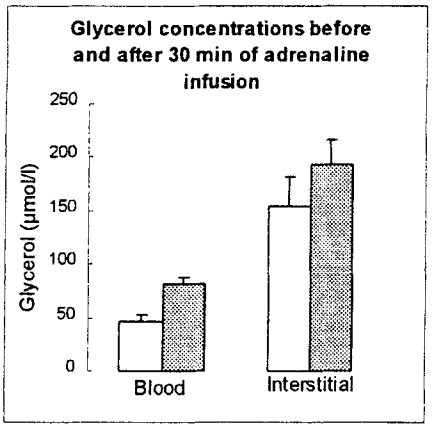
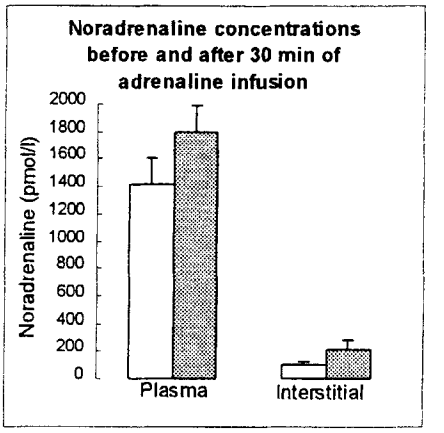
Microdialysis of adipose tissue to assess the effects of adrenaline infusion. By J.S. SAMRA[1], E.J. SIMPSON[2], C.D. FORSTER[2], M.L. CLARK[1], S.M. HUMPHREYS[1], I.A. MACDONALD[2] and K.N. FRAYN[1], *[1]Oxford Lipid Metabolism Group, Radcliffe Infirmary, Oxford OX2 6HE and [2]Department of Physiology and Pharmacology, Medical School, Queen's Medical Centre, Nottingham NG7 2UH*

Adipose tissue stores metabolic fuel in the form of triacylglycerol (TAG). The intracellular TAG can be mobilized by lipolysis to yield three molecules of non-esterified fatty acid (NEFA) and a molecule of glycerol. Glycerol can be used as an index of lipolysis because unlike NEFA it cannot be reutilized by the adipose tissue (Vaughan, 1961). Microdialysis is a technique which can be used to measure concentrations of various metabolites in the interstitial fluid. Both plasma noradrenaline and glycerol concentrations can be elevated by adrenaline infusion (Freyschuss *et al* 1986). We used adrenaline infusion to study the differential changes in the noradrenaline and glycerol concentrations both in the plasma and in the interstitial fluid of adipose tissue.

Seven healthy volunteers (median age 26 (range 23-41) years ; median BMI 23.8 (range 20.7-28.9) kg/m^2) were studied after an overnight fast. Arterialized blood was obtained from a hand vein which was warmed in a box at 65° and another cannula was placed into the basilic vein for adrenaline infusion. Three microdialysis probes were inserted into the adipose tissue of the anterior abdominal wall with the aid of cannulas. The no net flux technique (Lönnroth *et al.* 1987) was used to measure baseline interstitial concentrations and then adrenaline was infused through the forearm cannula at a rate of 25 ng/kg per min for 1 h.





The basal interstitial glycerol concentration was significantly greater than the blood glycerol concentration (see Figure ; $P < 0.05$). Thirty minutes of adrenaline infusion caused a significant rise in both blood and interstitial glycerol concentration (blood 47 (SE 6) to 82 (SE 5) μmol/l: $P < 0.05$; interstitial 155 (SE 26) to 194 (SE 23) μmol/l: $P < 0.05$). The basal interstitial noradrenaline concentration was significantly lower than the plasma concentration (interstitial 102 (SE 18) pmol/l, plasma 1410 (SE 195), $P < 0.001$), but the adrenaline infusion only significantly increased the plasma noradrenaline concentration (plasma 1410 (SE 195) to 1800 (SE 190) pmol/l: $P < 0.005$; interstitial 102 (SE 18) to 212 (SE 72) pmol/l). The significant difference between the concentrations of glycerol and noradrenaline in the plasma and in the adipose tissue interstitial fluid reflects whole body and organ metabolism.

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Influence of variation in dietary fatty acid composition on von Willebrand's factor concentration in healthy men. By FRANCESCA OAKLEY, T.A.B SANDERS and J.D. PEARSON, *Nutrition, Food and Health Research Centre, King's College London, Campden Hill Road, London W8 7AH*

von Willebrand's factor (vWbF) is an adhesion molecule expressed by endothelial cells. Deficiency of vWbF leads to decreased platelet adhesion and a prolonged bleeding time. More recently, elevated levels of vWbF have been associated with increased risk of coronary heart disease (Thompson *et al.* 1995). Previous studies have shown that the *n*-3 fatty acids in fish oil increase bleeding time (Sanders & Roshanai, 1983). We have measured vWbF in subjects receiving diets of varying fatty acid composition for 3-week periods. All diets were isoenergetic and supplied approximately 30% energy as fat. A high-saturated-fat diet, designed to be reflective of the normal British diet, was used as a control and supplied 15% energy as saturates (SFA), 10% energy as monounsaturates (MUFA) and 3.5% energy as *n*-6 polyunsaturated fats. The other two diets were both designed to be high in monounsaturates (15% energy), and low in saturates (10% energy) with either an additional 2% energy from *n*-6 fatty acids mainly as linoleic acid (18:2*n*-6), or 2% energy from the *n*-3 fatty acids eicosapentaenoic acid (20:5*n*-3) and docosahexaenoic acid (22:6*n*-3) provided as fish oil. Results are shown in the Table below.

	High SFA (n # 25)		MUFA + *n*-6 (n # 25)		MUFA + *n*-3 (n # 25)	
	Mean	SE	Mean	SE	Mean	SE
vWbF (U/ml)	0.35	0.027	0.65**	0.108	0.63**	0.085

** $P< 0.01$ compared with the high-SFA diet.

A significant increase in vWbF was observed after both the MUFA+*n*-6 and the MUFA+*n*-3 diets when compared with the high-SFA control diet. These results were contrary to expectations and may reflect a homeostatic mechanism responsive to differences in blood flow through small capillaries. Further work is necessary to determine whether the increase in vWbF is a response to a high-MUFA diet or the increased levels of polyunsaturates in the test diets.

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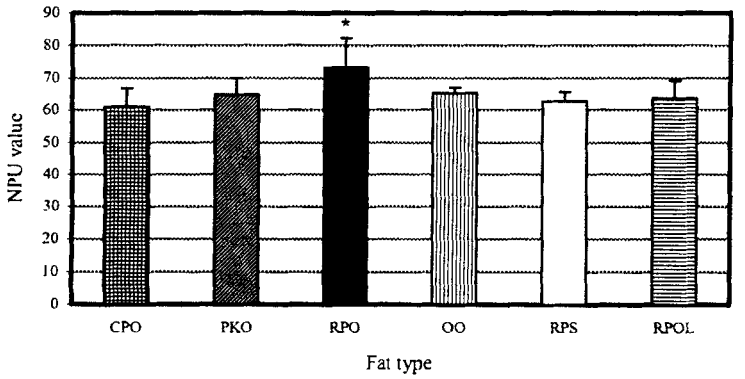
The influence of palm oil and palm-oil fractions on protein utilization in the rat. By C.J.K. HENRY, A. GHUSAIN-CHOUEIRI and M.I. GURR, *School of Biological and Molecular Sciences, Oxford Brookes University, Gipsy Lane, Oxford OX3 OBP*

Thomasson (1955) reported that dietary fat source may influence growth rate in rats. Subsequently, it was shown that fat source can influence N balance (Naismith & Quareshi, 1962; Barta-Bedo, 1963). The aim of the present study was to investigate the influence of dietary palm-oil fractions on protein utilization in rats, with olive oil as a reference.

Weanling male Sprague-Dawley rats were given stock diet (RM1 expanded, SDS Ltd., Witham, Essex) for 7 d. At 30 d of age, groups of four were offered one of six semi-purified diets that differed only in the type of fat. Diets contained 200 g casein, 550 g carbohydrate (400 g sucrose and 150 g corn-meal), 50 g mineral and vitamin mix and 200 g fat/kg diet. The different fat types were: crude palm oil (CPO), refined palm-kernel oil (PKO), refined palm olein (RPO), olive oil (OO, control), refined palm stearin (RPS), and refined palm oil (RPOL). The efficiency of utilization of dietary protein was assessed by net protein utilization (NPU) using a modified 10 d comparative carcass technique (Miller & Bender, 1955).

Weight gain was not significantly influenced by fat type. The NPU of rats given RPO was significantly higher ($p<0.05$) than that of rats given all other palm-oil fractions and the OO control.

NPU for rats fed on various palm-oil fractions



Values are the means with SD (n 4-6 trials each). Significantly different, ANOVA: *$P<0.05$.

It is concluded that RPO has the potential to improve NPU significantly and hence, protein retention. More studies are in progress to identify the mechanism whereby the lipid fraction influences N balance. It is proposed that a human trial, with palm olein as the fat source during nutritional rehabilitation of malnourished children, may be a practical outcome of these studies.

This work was funded by the Palm Oil Research Institute of Malaysia.

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The effect of varying the *n*-6:*n*-3 fatty acid ratio of the diet upon blood lipid concentrations in the rat. By N.M. JEFFERY, E.A. NEWSHOLME and P.C. CALDER, *Department of Biochemistry, University of Oxford, South Parks Road, Oxford OX1 3QU*

Diets with a high saturated fatty acid (SFA) content have been linked with an increase in blood lipid levels and an increased incidence of coronary artery disease (Keys, 1970). In comparison, unsaturated fats have been shown to decrease blood lipid levels (FAO/WHO, 1978). This has led to interest in replacing dietary SFA with unsaturated fat. Dietary fish oils (rich in the *n*-3 polyunsaturated fatty acids (PUFA) eicosapentaenoic acid and docosahexaenoic acid) or linseed oil (rich in the *n*-3 PUFA α-linolenic acid) have been shown to lower blood lipid levels compared with *n*-6 PUFA-rich diets (Garg *et al.* 1988; Rustan *et al.* 1992; Yaqoob *et al.* 1995). There is, however, little information on how much *n*-3 PUFA is required to bring about these effects, especially in relation to the *n*-6 PUFA content of the diet.

In the present study, a series of diets with different *n*-6:*n*-3 ratios were fed to weanling male Lewis rats for 6 weeks. The diets contained 200 g/kg of either sunflower oil (rich in *n*-6 PUFA), linseed oil or a combination of the two oils to give the *n*-6:*n*-3 ratios of 100:1 (all sunflower oil), 15:1, 7:1, 1:1 and 0.3:1 (all linseed oil). Upon slaughter, blood was collected and serum prepared. The concentrations of total cholesterol, triacylglycerols (TG) and non-esterified fatty acids (NEFA) were determined by standard enzymic procedures.

	Total cholesterol (mg/ml)		TG (mg/ml)		NEFA (mg/ml)	
n-6:*n*-3 ratio	Mean	SEM	Mean	SEM	Mean	SEM
100:1	1.20	0.06	0.87	0.12	0.67	0.02
15:1	1.21	0.05	0.62	0.08	0.56	0.04
7:1	1.14	0.04	0.73	0.12	0.51*	0.03
1:1	1.08	0.04	0.50	0.10	0.54*	0.04
0.3:1	0.93*†‡	0.04	0.36*†‡	0.05	0.49*	0.03

Values are means for six animals fed on each diet with their standard errors.

Mean values were significantly different from: *100:1 diet, †15:1 diet and ‡7:1 diet ($P<0.05$, ANOVA).

The concentrations of total cholesterol, TG and NEFA in the serum all progressively decreased with a decrease in the *n*-6:*n*-3 ratio of the diet. The total cholesterol and TG concentrations in the serum of animals fed on the 0.3:1 diet were significantly lower than those of animals fed on the 100:1, 15:1 and 7:1 diets. The serum TG concentration of rats fed on the 0.3:1 diet was lower than that previously observed after fish-oil feeding (0.60 mg/ml; Yaqoob *et al.* 1995). The NEFA concentrations in the serum of animals fed on the 7:1, 1:1 and 0.3:1 diets were all significantly lower than that of animals fed on the 100:1 diet.

These results show that dietary *n*-3 PUFA have a blood lipid-lowering effect in rats irrespective of their source (i.e. fish oil or linseed oil). Futhermore the presence of only a small proportion of *n*-3 PUFA in the diet is sufficient to lower blood lipid levels compared with a *n*-6 PUFA-rich diet.

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The effects of anaesthesia (Halothane & Chloroform) on postprandial glycogen and lipid synthesis in rats. By P. M. C. HO, O. A. OBEID and P. W. EMERY, *Department of Nutrition and Dietetics, King's College London, Campden Hill Road, London W8 7AH*

The rates of synthesis of glycogen and fatty acids can be measured in vivo by injecting rats with ^3H_2O and measuring the incorporation of ^3H into the macromolecules 1 h later. Precursor labelling is estimated from the specific radioactivity of plasma water. However the results could be affected by the method used to terminate the experiment and take the samples of blood and tissues because many anaesthetics are known to cause glycogenolysis, lipolysis and hyperglycaemia (Biebuyck *et al.* 1974). The present study was performed to assess the magnitude of these effects.

Groups of four male Sprague-Dawley rats weighing approximately 200 g were fed for 7 d on a semi-synthetic diet supplying 20% energy as protein, 23% as fat and 57% as carbohydrate. After an overnight fast they were tube fed a 16 KJ liquid meal of the same composition and were given an intraperitoneal injection of ^3H_2O. All rats were killed 1 h later and samples of liver and epididymal fat pads (EFP) were rapidly removed. Two groups were anaesthetized, with either chloroform or halothane (4%), 5 min before being killed, and blood was drawn from the heart at the time of death; a third (control) group was killed by decapitation without anaesthesia and blood was collected from the neck vessels.

	Chloroform	Halothane	Decapitation	Pooled SE
Plasma glucose (mmol/l)	11.1*	9.1	8.1	0.41
Hepatic glycogen content (mg/g)	16.2*	16.8*	20.7	1.05
Hepatic glyconesis†	58.8*	81.2*	189	19.4
Hepatic lipogenesis‡	7.9*	11.1	14.3	1.04
EFP lipogenesis‡	14.6	13.4	12.9	2.07

* Significantly different from decapitation group, $P<0.05$ using Dunnett's test.

† μmol ^3H_2O incorporated into glycogen/g tissue per h. ‡ μmol ^3H_2O incorporated into saponifiable lipid/g tissue per h

Both anaesthetic agents caused a significant reduction in the final liver glycogen content in comparison with the control (decapitation) group. Since the rats were only anaesthetized for 5 min the magnitude of the difference suggests rapid breakdown of glycogen rather than simply suppression of glycogen synthesis. In the case of chloroform treatment this resulted in a significant increase in plasma glucose concentration. The amount of isotope incorporated into glycogen was reduced by even more than the reduction in glycogen content, suggesting preferential breakdown of the most recently synthesized glycogen. Hepatic lipogenesis was also suppressed by anaesthesia, although the difference was statistically significant only in the case of chloroform. In contrast, lipogenesis in adipose tissue was not affected. Thus both anaesthetic agents had profound effects on glycogen and lipid metabolism, the effects of chloroform being more severe than those of halothane. The use of any inhalational anaesthetic should be avoided if possible when measuring rates of glycogenesis and lipogenesis *in vivo*.

Financial support from the American Institute of Cancer Research is gratefully acknowledged.

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The effect of age on the utilization of infused glucose studied using the hyperglycaemic glucose clamp. By CERI J. GREEN, I.T. CAMPBELL and D.P.M. MCLAREN, *University Department of Anaesthesia, Royal Liverpool University Hospital, Liverpool L69 3BX.*

Glucose is used in intravenous nutrition; resistance to glucose utilization increases with age (Fink *et al.* 1983). The hyperglycaemic glucose clamp (De Fronzo *et al.* 1979) combined with indirect calorimetry allows glucose utilization rate (GUR), oxidation and non-oxidative disposal (storage) induced by glucose infusion to be calculated. The effect of age on the response to infused glucose was studied in ten normal subjects (7M 3F; aged 22-55, median 41 years; height 1.57-1.88, median 1.685 m; weight 53.1-95, median 74.5 kg; BMI 20.2-28.4, median 25.05 kg/m^2).

Following an overnight fast subjects attended the laboratory at 08.30hours; they emptied their bladder and intravenous cannulas were inserted for infusion of 200 g/L D-glucose and blood sampling respectively. They rested for 30 min. 0_2 consumption and $C0_2$ production were measured for 30 min and glucose was then infused to raise the blood concentration acutely to 12 mmol/l. It was maintained at 12 mmol/l for a further 160 min by sampling blood at 5 min intervals and adjusting the infusion rate in accordance with the algorithm of De Fronzo *et al.* (1979). Urinary N was measured. Respiratory exchange ratio increased steadily over the course of the infusion. Exogenous glucose utilization and energy expenditure did not alter for 90 min then rose steadily over the ensuing 90 min. Correlations were sought at 120-180 min between the age of the subjects and GUR, oxidation (calculated from indirect calorimetry, and urinary N) and storage, and the absolute and percentage changes (Δ) from 40-80 min to 120-180 min.

	All subjects (n 10)		Males only (n 7)	
	r	*P*	*r*	*P*
GUR	-0.496	0.145	-0.857	0.014
ΔGUR	-0.441	0.202	-0.823	0.023
ΔGUR-(%)	-0.2003	0.513	-0.239	0.255
Oxidation	-0.614	0.059	-0.917	0.004
ΔOxidation	-0.563	0.093	-0.894	0.007
ΔOxidation-(%)	-0.337	0.341	-0.619	0.139
Storage	-0.496	0.145	-0.917	0.004
ΔStorage	-0.372	0.289	-0.690	0.087
ΔStorage-(%)	-0.231	0.520	-0.333	0.466

Exogenous GUR, glucose oxidation, non-oxidative disposal and changes in these variables all showed a significant decline with age in the male subjects only, but not when expressed as a percentage of the initial values. In males exogenous GUR declines with age, but the proportions oxidized and stored do not.

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Acute effects of high-sucrose v. high-starch diets on insulin sensitivity in healthy volunteers. By M.DALY, C.VALE, A.LITTLEFIELD, M.WALKER, K.G.G.M.ALBERTI and J.C.MATHERS, *Human Nutrition Research Centre, Department of Biological and Nutritional Sciences and Department of Medicine, University of Newcastle, Newcastle upon Tyne NE1 4LP*

Reduced insulin sensitivity is thought to be a major feature in the pathogenesis of Type II diabetes mellitus, hypertension and ischaemic heart disease. Studies in laboratory animals suggest that high-fructose or high-sucrose diets impair insulin sensitivity (Thorburn *et al.* 1989) but results from human studies have been inconsistent.

Eight healthy, non-obese subjects were recruited to a randomized crossover experiment in which diets providing 50% of energy as starch or sucrose were fed for 24 h. Fat and protein contents were fixed at 35% and 10% of dietary energy respectively (monounsaturate : saturate : polyunsaturate fatty acid ratio of 1:1:1 in both diets).

A modified insulin tolerance test (Akinmokun *et al.* 1992) was used to assess insulin sensitivity (quantified as the rate constant (Kitt) for fall in glucose and non-esterified fatty acid (NEFA) concentrations) at the end of the 24 h period. Blood glucose, NEFA, insulin and triacylglycerol profiles over the 24 h period were measured.

	Kitt'		AUC (Total)		AUC (Insulin)		AUC (NEFA)	
Diet	Glucose	NEFA	Glucose	NEFA	Lunch*	Dinner*	Dinner*	Overnight†
Starch	3.72	11.4	2166	93.5	588	825	4.73	39.4
Sucrose	3.86	12.9	1948	112.9	1180	1298	7.46	52.6
SEM	0.226	1.18	22.1	11.2	131	113	0.87	5.38
Probability	0.54	0.24	<0.0005	0.13	0.003	0.004	0.017	0.045

* For 2 h post-meal.

† 22.00 - 06.00 hours.

No differences were detected in insulin sensitivity for either glucose or NEFA.

Total area under the curve (AUC) measurements showed no significant differences between diets for insulin, NEFA or triacylglycerols, but AUC was lower for glucose with the sucrose diet largely because of lower blood glucose concentrations in the period 08.00-18.00 hours. NEFA concentrations were significantly higher on the sucrose diet following the two larger meals (lunch and dinner).

In conclusion there were no detectable changes in insulin sensitivity after 24 h exposure to diets of contrasting carbohydrate type. The elevated NEFA concentrations during later parts of the day with the sucrose diet may be due to more rapid absorption of sugars leading to less available glucose at later times.

This research is supported by Ministry of Agriculture, Fisheries and Food (Project AN 0309).

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The effect of acute Acipimox administration on the contribution of different pathways to postprandial glycogen synthesis in cachectic tumour-bearing rats. By O.A. OBEID[1], J.D. BELL[2] and P.W. EMERY[1], [1]*Department of Nutrition and Dietetics, King's College London, London W8 7AH* and [2]*Robert Steiner MR Unit, Hammersmith Hospital, Du Cane Road, London W12 0HS*

We have previously found that the rate of postprandial glycogen synthesis in the livers of tumour bearing rats was greater than that of control rats, and that glycogen was derived mainly via the indirect pathway involving gluconeogenesis (Matthews *et al.* 1991). This may be a cause of increased energy expenditure in cancer cachexia. We have therefore determined the extent to which Acipimox, an antilipolytic and antigluconeogenic compound, is able to suppress the indirect pathway of glycogen synthesis. Sixteen male Fischer 344 rats bearing a transplantable Leydig-cell tumour (TB) and sixteen *ad libitum*-fed controls (AD) were fasted overnight, then tube fed a 19 KJ liquid meal containing 200 mg [1-^{13}C] glucose and injected intraperitoneally with 7mCi of $^{3}H_2O$. Half the rats in each group received 10 mg Acipimox with the meal. The rats were killed 1 h later and blood and livers were taken for analysis. The rate of glycogen synthesis was calculated as μmol $^{3}H_2O$ incorporated into glycogen-glucose/h per g tissue; the percentage of glycogen derived via pyruvate was calculated from the ratio of ^{3}H labelling at C6 to that at C2 in the glycogen-glucose (Kuwajima *et al.* 1986); and the direct pathway contribution to glycogen synthesis from glucose was determined by NMR analysis of the proportion of ^{13}C incorporated at C1 in the glycogen-glucose (Wehmeyer *et al.* 1994).

	Control		Acipimox			Analysis of variance		
	AD	TB	AD	TB	Pooled SE	TB	A	TBxA
Plasma glycerol (μmol/l)	206	174	127	142	27.4	NS	***	NS
Glycogen synthesis	48.4	77.8	38.1	50.3	5.41	***	***	NS
Glycogen via pyruvate (%)	47.4	50.0	43.2	44.9	3.22	NS	NS	NS
Direct pathway (%)	36.4	40.5	38.2	33.5	5.15	NS	NS	NS

*** $P<0.001$.

Acipimox administration caused a decrease in plasma glycerol concentration, presumably because of decreased lipolysis. TB rats showed a higher rate of $^{3}H_2O$ incorporation into glycogen than control rats, and this was suppressed by Acipimox. The percentage of glycogen derived via pyruvate was similar between all the groups, as was the contribution of the direct pathway to glycogen synthesis from glucose. These results suggest that Acipimox may have suppressed glycogen synthesis from glycerol, but it had no significant effect on glycogen synthesis from other precursors.

Financial support from the American Institute of Cancer Research is gratefully acknowledged. Acipimox was a gift from Farmitalia Carlo Erba, Milan, Italy.

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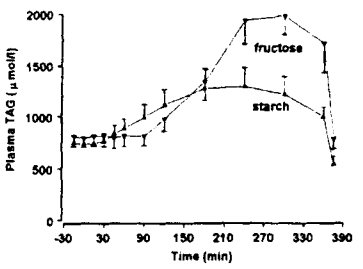
Acute augmentation of postprandial lipaemia by fructose. By AREFAINE ABRAHA, SANDY M. HUMPHREYS and KEITH N. FRAYN, *Oxford Lipid Metabolism Group, Radcliffe Infirmary, Oxford OX2 6HE*

The plasma triacylglycerol (TAG)-elevating effect of diets containing high levels of fructose or sucrose has been shown in many studies. There appears to be a particularly marked effect on postprandial lipaemia (Hayford *et al.* 1979). However, some uncertainties still remain. It is not clear whether fructose added to a meal has an acute effect on postprandial lipaemia, since in most of the dietary studies test meals were used which were part of the current diet. An exaggerated postprandial lipaemia has been observed in acute studies in which fructose has been added to a single test meal, but in these studies there was no control of the total carbohydrate of the test meal (Cohen & Schall, 1988; Jeppesen *et al.* 1995). The mechanism by which dietary sugars elevate the plasma TAG concentration is not clear. Whilst animal studies suggest increased hepatic TAG secretion, there is also evidence for decreased TAG clearance (Grant *et al.* 1994). We have investigated the acute effect of fructose on postprandial lipaemia in comparison with an equal amount of starch.

Six healthy volunteers (three male and three female) with a mean age of 48 (SD 10.5) years and a mean BMI of 22.9 (SD 3.1) kg/m^2 attended on two occasions after overnight fast. They were given a test meal consisting of scrambled egg cooked in double cream and butter and providing 1 g fat/kg body weight. On one occasion this was given with fructose, 0.75 g/kg body weight dissolved in water; on the other, the fructose was replaced by starch, 0.75 g/kg in the form of toast. Blood samples were taken before and hourly for 6 h after the meal. After the 6 h sample, heparin (100 units/kg) was given intravenously and a blood sample for estimation of lipoprotein lipase (*EC* 3.1.1.34) activity was taken 15 min later.



The Figure shows that fasting TAG concentrations were similar on both study days, but were increased by 50 % after fructose in the period from 3 - 6 h after the meal. This was significant by comparison of areas under the curves (P<0.02). Concentrations of blood glucose and plasma non-esterified fatty acids were not significantly different after the two meals, although plasma insulin concentrations were slightly lower after the fructose meal (P<0.05). Post-heparin plasma lipoprotein lipase activity (nmol/min per ml) was slightly but not significantly lower after fructose (mean 180, SE 35) than after starch (mean 210, SE 28) (P=0.09).

These results show a specific, acute augmentation of postprandial lipaemia by fructose. Further studies are required to clarify the mechanisms involved.

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Glutaminase (EC 3.5.1.2) and glutamine synthetase (EC 6.3.1.2) activities in the gastrointestinal tract of humans. By L.A. JAMES[1], P.G. LUNN[1], M. ELIA[1], J.O. HUNTER[2], G. NEALE[2] and S. MIDDLETON[2], [1]*MRC Dunn Nutrition Centre, Cambridge CB4 1XJ and* [2]*Department of Gastroenterology, Addenbrookes Hospital, Cambridge CB2 2QQ*

Glutamine is a major nutrient for the gastrointestinal (GI) tract and its inclusion in parenteral and enteral nutrition regimen has been shown to help maintain gut integrity, structure, and function in the critically ill. However, very little information is available concerning the extent of its metabolism and the distribution of key enzymes involved in its synthesis (glutamine synthetase) and degradation (glutaminase). Within the GI tract such enzyme distribution studies can provide a more specific insight into glutamine metabolism than is possible from arterio-venous catheterization studies. The present investigation aimed to establish the distribution of glutamine synthetase and glutaminase in mucosal tissue throughout the GI tract from the oesophagus to the rectum.

Small biopsy specimens with wet weights ranging between 2.0 and 12.7 mg were obtained from the digestive tract of patients undergoing endoscopic examination for dyspepsia or colonoscopic examination for possible recurrence of colonic polyps. To characterize the metabolism of the healthy bowel, biopsy specimens were obtained from a group of patients between the ages of 35 and 65 years who had no apparent GI abnormalities. Samples were immediately weighed and homogenized in 500 μl Tris/EDTA buffer. Enzyme activities were determined by radiochemical techniques based on the conversion of [^{14}C]glutamine to [^{14}C]glutamate and vice versa (Fox *et al.* 1988). Separation of glutamine and glutamate following incubation was achieved using AG-1X8 Dowex anion exchange resin.

The Table shows activities of both enzymes in mucosal biopsy specimens taken throughout the GI tract.

	Glutamine synthetase (nmol glutamine/min per mg protein)			Glutaminase (nmol glutamate/min per mg protein)		
Tissue	*n*	Mean	SE	*n*	Mean	SE
Oesophagus	6	0.17	0.12	6	6.1	2.0
Upper stomach	6	4.43	1.14	6	10.8	2.7
Lower stomach	6	0.48	0.22	6	7.8	1.4
Small intestine	10	0.08	0.03	10	47.0	6.1
Large intestine	36	0.12	0.03	36	26.8	1.6

The small intestine was sampled in two areas, the duodenum and ileum, and large-intestinal biopsies were obtained from six different sites, but mean values for each are presented in the Table. The highest glutaminase activity was observed in the small intestine (duodenum, 52.8 > ileum, 38.2 nmol glutamate formed/min per mg protein); but substantial activity was also found in the large intestine, (caecum, 31.1 > descending colon, 30.1 > transverse colon, 26.3 > ascending colon, 24.0 > sigmoid colon, 21.7 > rectum 18.9 nmol glutamate formed/min per mg protein. Glutamine synthetase activity was low for all regions (0.03-0.48 nmol glutamine formed/min per mg protein) apart from the upper stomach (4.43 nmol glutamine formed/min per mg protein). These results suggest that (1) the mucosa of the upper stomach has potential for synthesizing glutamine, in contrast to the rest of the GI tract which has little such potential; (2) both the small and large intestines have a high capacity for glutamine metabolism, but very limited synthesizing potential, and thus both must be expected to derive their glutamine from other sources. Such information may help rationalize the use of glutamine for treating diseases that affect different parts of the GI tract.

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Influence of *n-3* fatty acids on postprandial lipaemia and factor VII coagulant activity. By NAJAT YAHIA and T.A.B. SANDERS, *Nutrition, Food and Health Research Centre, King's College London, Campden Hill Road, London W8 7AH*

Chronic feeding studies have found that *n-3* fatty acids (Oakley *et al.* 1994) decrease postprandial lipaemia and some acute feeding studies suggest that *n-3* fatty acids lead to less lipaemia than monounsaturated fatty acids (Williams *et al.* 1992). We have shown previously that long-chain fatty acids can induce activation of factor VII (Yahia *et al.* 1995). Other studies have shown that lipoprotein lipase activity (*EC* 3.1.1.34) is necessary for the activation of factor VII. In the present study we compared the effects of fish oil (MaxEPA, Seven Seas) with olive oil at different levels of total fat intake. Test meals were administered to twelve subjects in a randomized block design. The test meals were isoenergetic and varied only in their source and level of fat: they contained 90 g olive oil, 75 g olive oil + 15 g MaxEPA , 15 g olive oil or 15 g MaxEPA. Subjects received a low fat diet on the day prior to the test meal. Fasting samples were taken and non-fasting samples were obtained at 2, 3, 4, and 7 h after the test meal for triacylglycerol (TAG) and factor VIIc assays. The results are shown in the Table

	90 g olive oil		75 g olive oil + 15 g MaxEPA		15 g olive oil		15 g MaxEPA	
	Mean	SE	Mean	SE	Mean	SE	Mean	SE
Factor VIIc (% standard)								
0 h	81	5.6	85	6.6	82	7.4	81	5.9
3 h	93[a]	5.6	94[a,b]	7.5	85[c,b]	8.4	82[c]	5.4
7 h	93[a]	6.5	94[b]	8.1	83[c]	8.8	83[c]	7.8
TAG AUC	9.92[a]	1.7	6.91[b]	1.4	1.66[c]	0.5	2.17[c]	0.8

Values with different superscript letters [a,b,c] in the same row were significantly different $p < 0.05$.
AUC. total area under the curve described by serum triacylglycerol concentrations plotted against time to 7 h.

Neither of the low-fat diets led to any changes in the plasma TAG concentration or factor VIIc activity. The 90 g dose of olive oil led to increased postprandial lipaemia compared with admixture of olive oil and MaxEPA. Factor VIIc was increased by both these high fat loads compared with the 15 g loads. Our results show that the consumption of *n-3* fatty acids acutely decreases postprandial lipaemia. We suggest that failure of MaxEPA to decrease the activation of factor VIIc may be due to an acute effect on the splanchnic blood flow which would increase lipolytic activity.

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Long-term effects of restriction of dietary protein during pregnancy and/or lactation on the growth of the organs of the gastrointestinal tract. By L.T.WEAVER[1], M.DESAI[2,3], S.AUSTIN[2], A.LUCAS[2] and C.N.HALES[3], [1]*Department of Human Nutrition, University of Glasgow, G3 8SJ,* [2]*MRC Dunn Nutrition Unit , Cambridge CB4 1XJ and* [3]*Department of Clinical Biochemistry, University of Cambridge, CB2 2QQ*

Undernutrition during early life may have both immediate and long-term consequences (Widdowson & McCance, 1963). At weaning the digestive systems of the progeny of protein-restricted pregnant and lactating rats are reduced in size (Young *et al,* 1987), but there have been no studies of their growth to adulthood. To measure the effects of protein restriction on the long-term growth of the organs of the gut, we assigned pregnant rats to one of four groups that received diets restricted in protein as follows: Group 1: 220 g/kg casein during pregnancy and lactation (controls); Group 2: 90g/kg casein during pregnancy and lactation; Group 3: 220 g/kg casein during pregnancy, 90 g/kg casein during lactation; Group 4: 90 g/kg casein during pregnancy, 220 g/kg casein during lactation.

Animals were killed, their gastrointestinal tracts removed and the weights of the stomach and caecum, and the lengths of small and large intestines measured, at 21, 42 and 365 d. There were six animals in each group. Weights and lengths of the organs of the gut (W/L), and per gram weight of animal (/g), were expressed as mean percentage of control animals (group 1).

Age (d)...	21		42		365			21		42		365	
%	W	/g	W	/g	W	/g		L	/g	L	/g	L	/g
Stomach							Small intestine						
Group 1	100	100	100	100	100	100	Group 1	100	100	100	100	100	100
Group 2	54	110	87	98	94	103	Group 2	76	155	97	110	99	111
Group 3	59	123	88	102	106	113	Group 3	85	178	91	105	94	101
Group 4	84	92	98	88	114	106	Group 4	94	102	105	94	100	97
Caecum							Large intestine						
Group 1	100	100	100	100	100	100	Group 1	100	100	100	100	100	100
Group 2	57	115	91	100	86	97	Group 2	86	177	92	104	101	110
Group 3	61	126	97	109	114	121	Group 3	92	191	99	113	100	107
Group 4	81	85	121	107	111	107	Group 4	92	100	107	94	99	98

At 21 d the body weights of groups 2 and 3 were halved, with 40-50% reductions in the weights of the stomach and caecum, compared with controls ($P<0.0001$). The lengths of the small and larg intestines were also reduced ($P<0.005$), but not relative to body weight. By 42 d the effects were less marked. Although the body weights of both groups 2 and 3 were reduced to 88% and 86% of controls, relative to body weight, the weights and lengths of the digestive organs were all within 13% of controls. At 1 year body weights of group 2 remained more than 10% lighter than controls, with gastric and caecal weights also proportionately smaller. Group 4 showed body-weight gain in excess of group 1, and by 1 year the lengths of the small and large intestines, and weight of the stomach, were proportional to body weight, and only caecal weight was relatively heavier ($P<0.05$).

Prenatal undernutrition alone has no significant long-term negative effects on body weight or growth of the gastrointestinal tract. Postnatal protein restriction has a marked effect on body weight, and weight and length of the organs of the gastrointestinal tract in early life, but by 1 year the weights and lengths of all of these organs are of the same or greater relative proportions as in control animals. Undernutrition in early postnatal life leads to underweight adults, but does not have a selective negative effect on the growth of the organs of the gastrointestinal tract. Indeed the growth of the digestive system appears to be preserved in the face of perinatal protein restriction.

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Management of malnutrition in the elderly:- a clinical audit. By Johan W Rademaker, Cheryl Richards, Judy Marsham, Joe Wheeler, Pat Batty, Jenny Summerell and Helen Williams, *Department of Elderly Care Medicine, St Martins Hospital, Combe Down, Bath BA2 5RP.*

Malnutrition in hospital remains a common problem and is associated with increased complications and costs. A prospective audit of the management of malnutrition for new admissions and patients prescribed oral supplements was carried out at St Martins Hospital during March 1994 and was re-audited in March 1995. Audit criteria and indicators were set by a multidisciplinary group and included: (1) admission and weekly weights; (2) documentation of risk factors; (3) referrals to dietitians for malnourished or at-risk patients; (4) use of oral supplements. Exceptions for the above criteria were patients admitted for terminal care and patients treated with diuretics for heart failure. Nutritional status was formally assessed on admission using anthropometric measurements (BMI, mid-arm circumference and triceps skinfold thickness). Protein-energy malnutrition (PEM) was defined as presence of 2/3 variables below age-controlled normal values.

A nutrition working party was formed after the first audit, and the following recommendations made: (a) admission and weekly weights to be carried out; (b) nutrition risk assessment forms to be introduced; (c) ward-based education of all staff should be introduced; (d) nutrition supplements to be prescribed on the drug chart and intake documented; (e) re-audit to be carried out during March 1995.

	March 1994	March 1995
Notes audited	106	96
Patients weighed on admission (%)	57	96
Patients weighed weekly (%)	29	76
Patients with malnutrition or at risk (n)	17	37
Referral to dietitian (n,%)	8 (47%)	16 (43%)
Patients with PEM (n,%)	8/26 (31%)	10/21 (48%)
Use of oral supplements mean actual/prescribed intake (%)	31	34

A summary of the comparison of the original audit in 1994 with the re-audit in 1995 is given in the Table. There was a marked improvement in the recording of both admission and weekly weights. No change in the documentation of problems related to nutrition occurred (results not shown), except for documentation of weight loss by nurses which improved when it became part of an assessment tool. Despite an increase in the number of patients recognized as having malnutrition or being at risk, no improvement in the referral rate to dietitians occurred. Also, no improvement in the amount of prescribed supplements taken by patients occurred.

The re-audit indicated that the education of staff about nutrition and the introduction of a nutrition risk score improved the identification of patients with malnutrition but not the process of referral for treatment. The use of oral supplements, despite being prescribed on the drug charts, still remained a problem as they were not well tolerated by patients. An improvement in the regular diet by the introduction of snacks would increase the intake of all patients as well as those requiring nutrition support.

Percutaneous endoscopic gastrostomy for stroke: increasing or evolving? By JUDY POTTER[1], VICKI POTTS[1], ELAINE SPEIRS[2], BIJAL PAVAGADHI[2] and JOHN MEYRICK THOMAS[1]. (Introduced by Ganesh Supramianiam). *[1]Nutrition Support Team and [2]Clinical Audit Department, Watford General Hospital, Vicarage Road, Watford, WD1 8HB.*

As part of an on-going outcome audit of nutrition management in a district general hospital, we have compared our experience with percutaneous endoscopic gastrostomy (PEG) provision for patients without safe swallowing following cerebro-vascular accident (CVA) in two 12 month periods: 1992 and 1994.

All PEG (12 F.G. Merck) were inserted in the operating department by one consultant surgeon or his surgical trainee under supervision, using minimal effective sedation, supplementary O_2, pulse oximetry monitoring and a single dose of intravenous cephradine 1 gram.

Data for 1992 were collected prospectively by the nutritional support nurse and those for 1994 retrospectively by clinical audit officers (from theatre registers, validated from dietitians', speech therapists' and gastrostomy clinic records and case notes). Analysis for each 12-month period was prepared 6 months after the year end (follow-up 6 - 18 months).

	1992	1994
Total number of PEG	32	58
Number of PEG for CVA	15	31
Age (years) range (mean)	58-92 (77)	56-91 (77)
Sex: (male : female)	6:9	16:15
Time from admission to PEG:		
<1 week	0	10%
1-3 weeks	30%	85%
>3 weeks	70%	5%
Outcome; discharge home : died in hospital	8:7	17:14
PATIENTS DISCHARGED HOME		
Time from admission to discharge in days; range (mean)	43-210 (90)	16-76 (52)
Number of patients eating without PEG : PEG still in situ	8:0	9:5*
Time to PEG removal in days: range (mean)	50-190 (125)	48-249 (133)
INPATIENT DEATHS		
Interval from PEG insertion to death in hospital:		
< 1 month	14%	86%
1-2 months	14%	14%
2-4 months	72%	0

*3 died at home

Results show a doubling of use of PEG and a move towards their insertion at an earlier stage of hospitalization following CVA between 1992 and 1994. Increased readiness by referring physicians to request PEG has been accompanied by a similarly aggressive approach to rehabilitation and speed of discharge from hospital. Outcome in terms of survival rate and, among survivors, frequency and speed of return to swallowing did not changed appreciably.

In 1994 the majority of deaths among patients with PEG occurred within 1 month of PEG placement. These deaths did not represent procedure-related mortality, but highlight the difficulty of predicting survival in the early stages after a stroke and consequent inevitable "wasted" procedures.

We conclude that, after CVA associated with unsafe swallowing, early PEG placement as part of a concerted multidisciplinary approach to early rehabilitation and discharge from hospital can be achieved safely and with a high probability of subsequent return to normal eating.

A cost utility analysis of home parenteral nutrition. By D.M. RICHARDS, J.L. SHAFFER and SIR MILES IRVING, University of Manchester Intestinal Failure Unit, Hope Hospital, Stott Lane, Salford, M6 8HD

Home parenteral nutrition (HPN) is an expensive, life-saving treatment for intestinal failure. An economic evaluation from the UK is long overdue. The present evaluation was performed from the broad perspective of the NHS and the alternatives to HPN are described. The present study aimed to measure the cost utility of HPN, to examine factors affecting the cost utility ratio and to determine whether current practice is the most cost-effective way of delivering nutrition to patients with intestinal failure.

Sixty-four patients with benign intestinal failure were monitored by the unit. The commonest diagnosis was Crohns disease (*n* 35) followed by mesenteric vessel occlusion. The mean age was 44.4 (range 17-70 years). Utility scores were obtained using a well established quality of life questionnaire. A range of survival was used for the quality adjusted life year (QALY) calculation, because of the lack of good survival data for UK patients. Resource consumption was determined in three phases, enumeration, measurement and valuation. Marginal cost per QALY gained values were obtained for the range of survival times. A sensitivity analysis was then performed.

The marginal cost per QALY (MC/Q) for an average patient was £68 975. Survival for only 1 year increased the ration to £85 829 and survival for 10 years decreased the ratio to £54 734. The use of HPN for patients over the age of 55 years increased the MC/Q to £126 865 compared with £58 233 for those patients less than 44 years of age. Treating a patient in hospital rather than at home increased the estimated MC/Q to £189 451 and the potential savings for a patient on HPN for 4 years are £170 506.

The current practice of home care is more cost-effective than keeping a patient in hospital. HPN is expensive but the technology is life-saving and can add many years of life. The results were particularly significant in the younger patients and treating intestinal failure at home rather than in hospital.

Long-term glucose homeostasis in patients on home parenteral nutrition. By NIGEL WILLIAMS, SHONA WALES, ANNE BRADLEY, DON BARBER, JON SHAFFER AND MILES IRVING. *Nutrition Unit, Hope Hospital, Salford, M6 8HD*

Infusion of parenteral nutrition solutions cause a rise in blood glucose level. The body responds by secreting insulin to counteract this hyperglycaemic event. Previous studies have demonstrated optimal glucose infusion rate to be 4 mg/kg/min (Wolfe *et al*, 1980). However, in patients receiving high calorie, cyclical nocturnal infusions, this figure is often exceeded. To study long-term glucose homeostasis in patients receiving home parenteral nutrition (HPN), we prospectively assessed the level of glycosylated haemoglobin (Hb A_{1c}) in 36 consecutive patients who were receiving glucose-based infusions. Those receiving electrolytes only and those who had had less than 3 months HPN were excluded.

The normal range for Hb A_{1c} in this laboratory is 2.8-4.9 %. The median age of patients studied was 43 (range 21-68) years. Five patients with Crohns disease were concurrently receiving prednisolone at 20, 10, 5, 5 and 4 mg respectively. All had normal Hb A_{1c} levels. One patient was an insulin-controlled diabetic (Hb A_{1c}- 4.2%) and one was on oral hypoglycaemics (Hb A_{1c}- 3.9%). One patient was receiving octreotide (Hb A_{1c}- 6.3%) and was the only patient to have an elevated Hb A_{1c}. No patient had symptoms or signs of recent or concurrent infection. The mean (SD) weekly glucose delivery was 2 052g (831.3), being delivered at a mean infusion rate of 41.39 g/hr (8.13). The mean Hb A_{1c} was 3.22 % (0.88) with a range of 2.0-6.3 %. Regression analysis demonstrated no significant correlation between glucose infusion rate and Hb A_{1c} ($r= -0.306$, $p= 0.07$) or between weekly glucose load and Hb A_{1c} ($r= 0.031$, $p= 0.85$).

These results suggest that patients on HPN receiving large quantities of intravenous glucose manage to prevent prolonged episodes of hyperglycaemia by developing an insulin response to their infusion. It is also noteworthy that neither diabetic patients demonstrated an elevated Hb A_{1c}. Significant hyperglycaemia does not appear to be a problem in patients receiving glucose-based solutions for HPN.

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Recent trends towards reducing energy prescription in parenteral nutrition patients: implications for clinical practice. By EILEEN MANNING[1], PETER TURNER[2] and ALAN SHENKIN[1], *Departments of [1]Clinical Chemistry and [2]Dietetics, Royal Liverpool University Hospital, Prescot Street, Liverpool L7 8XP*

The dangers of overprovision of parenteral nutrition (TPN) have recently been emphasized (Elia, 1995) and there is an overall trend towards reduction of the prescribed energy intake in acutely ill patients. The mean resting energy expenditure in surgical patients measured by indirect calorimetry has been found to be in the range of 5858-7531 kJ/24 h (Sandström et al, 1993). The energy expenditure on activity in the post-operative period is likely to be small (MacFie, 1984), indicating that the total energy expenditure of surgical patients rarely exceeds 8368 kJ/24 h. A modification of the Schofield equation (Schofield, 1985) is widely used to estimate energy requirements for adult patients. This formula predicts BMR based on weight, age and sex, and is then modified by factors to account for stress, mobility, specific dynamic action of food and temperature. A modification of the Schofield formula is advocated by the Parenteral and Enteral Nutrition (PEN) Group of the British Dietetic Association (1989) and has not yet been officially modified to reflect the recent recommended reduction in energy intake.

We carried out a small pilot study on fifty consecutive patients, in general surgical wards, twenty-nine male (mean age 54, range 17 - 78 years) and twenty-one female (mean age 53, range 19 - 87 years) prescribed TPN in the Royal Liverpool University Hospital during the first half of 1995. Weight in males ranged from 35 - 82.5 kg (mean 58 kg) and in females from 36 - 78 kg (mean 50 kg). Using the modified Schofield formula as recommended by the PEN Group, the mean energy requirement calculated for the males was 8803 kJ/d (range 6318 - 11 590 kJ/d) and for the females was 7301 kJ/d (range 5021 - 9707 kJ/d). Almost half (23) of these fifty patients were estimated to require more than 8368 kJ/d, and nearly a quarter (12) of these patients were estimated to require more than 9414 kJ/d.

These findings appear to indicate that scrupulous adherence to the current recommended method for estimation of energy requirements tends to overestimate requirements in surgical patients and alteration (perhaps by omitting to add 10% for specific dynamic action of food and/or by reducing the factor added for activity) may be justified. There is therefore an urgent need for a new and accurately validated formula for estimating the energy requirements of patients in need of nutritional support.

Patients who are prescribed TPN in our hospital receive, wherever possible, a standard all-in-one feed in a 3-litre bag. Until recently, our "Standard 1" contained 9 g N and 7531 non-N kJ (8577 total kJ) and our "Standard 2" 14 g N and 9205 non-N kJ (10 669 total kJ). In the light of recent recommendations, we have reduced the total energy content of our "Standard 1" to 7322 kJ and that of our "Standard 2" to 8159 kJ. We believe that this will result in a reduced risk of TPN-associated dyspnoea and other metabolic complications (such as abnormal liver function) and this will be evaluated in future studies.

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Factors affecting nutrition in early cystic fibrosis: resting energy expenditure, pulmonary inflammatory markers, body composition and genotype in a neonatally-screened population.

By M. THOMSON[1], R. GREER[1], B. MASTERS[1], G. CLEGHORN[1], R. WILMOTT[2], P.J. FRANCIS[1], R.W. SHEPHERD[1]. [1]*Children's Nutrition Research Centre / CF Clinic, Royal Brisbane Children's Hospital, Brisbane, Australia and* [2]*Division of Pulmonary Medicine, Children's Hospital Medical Centre, Cincinnati, Ohio, USA.*

Our earlier prospective studies of neonatally-screened cystic fibrosis (CF) infants suggest that energy imbalance exists early in life (Bowling *et al.* 1988; Greer *et al.* 1991) and although early treatment affords less morbidity and improved nutrition compared with clinically diagnosed CF patients (Bowling *et al.* 1988) subclinical alterations in the two most important metabolic body compartments, the body cell mass (BCM), and body fat (BF) still occur in the apparent absence of clinical lung disease (Greer *et al.* 1991). The present study examines resting energy expenditure (REE) per unit BCM by total body potassium, lung inflammatory markers (from bronchial lavage fluid (BLF) examination) and genotype in eighteen CF children (mean age 0.61(sd 0.25) years).

Compared with age-,sex-, and length-matched controls (n 13), those with the common severe ΔF508/ΔF508 genotype had lower %BF, relatively normal fat-free mass (FFM) and expanded percentage BCM ($p<0.01$). Mean REE was significantly greater per unit BCM (15%, $p<0.01$), but not per unit FFM. Mean REE in CF ΔF508/other genotype (n 7) did not differ from control values. Evidence from BLF of inflammation (including cultures, quantitative cytokine assays, neutrophils and colony counts) occurred equally in a high proportion of both CF genotype groups, but individually or collectively these infammatory markers were not correlated with high REE. Genotypic variation in energy expenditure is detectable early in CF unrelated to lung inflammation. Subclinical deficits in body composition and pulmonary integrity occur early in CF and in combination with increased cellular metabolic activity these findings have important clinical implications for early diagnosis and management.

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Screening for malnutrition in oncology patients. By R. MOORE, J. A. KRAMER, M. ELIA and S.A. JEBB, *MRC Dunn Clinical Nutrition Centre, Hills Road, Cambridge CB2 2DH*

Malnutrition in cancer has been reported in patients at the time of diagnosis (DeWys, 1977) and death (Warren, 1932) but few studies have examined the frequency of weight loss in patients during the course of their disease or its prevalence in clinical practice. The present study screened patients admitted to an oncology ward and attending out-patients at Addenbrookes Hospital in Cambridge for malnutrition, using a questionnaire and anthropometric measurements. A total of 125 outpatients were studied (forty-four males, eighty-one females). Common cancers were breast (24%), lung (13.6%), ovary (13.6%) and brain (9.6%). Mean age was 57.5 (SD 13.3; range 15 - 88) years. Over a 4-week period, fifty-five consecutive inpatient admissions to the oncology ward were studied (twenty-five males, thirty females). Common diagnoses were breast (22.2%), lung (9.3%) and oesophagus (7.4%) and the mean age was 56.1 (SD 15.4; range 15 - 80) years. These figures, whilst representative of this oncology population, do not reflect the national prevalence of cancer at these sites.

Weight at diagnosis was recorded in the notes of only 50.2% patients. There was no significant difference in self-reported pre-illness weight between in- and out-patients (mean 71.0 (SD 11.9) vs. 70.7 (SD 14.5) kg). Weight change between the onset of illness and the time of the assessment was very variable. Only 17% of out-patients were lighter than their pre-illness weight (mean weight change +3.39 (SD 9) kg) compared with 60% of in-patients (mean weight change -2.74 (SD 11) kg). In many patients weight changes were confounded by steroids; 43% of out-patients and 49% of in-patients were taking steroids and 22% and 38% respectively had visible signs of excess fluid. The Table shows BMI and skinfold values for both patient groups, in relation to population surveys (Office of Population Censuses and Surveys, 1993). Current reductions in appetite were rare. However 78% of in-patients and 76% of out-patients reported a transient decrease in appetite at some point since diagnosis. In out-patients the major causative factors were mouth dryness (29%), nausea (29%), 'filling up quickly' when eating (28%), and taste changes (27%); in inpatients fatigue (64%), mouth dryness (62%), taste changes (54%) and 'filling up quickly' (51%) were the commonest factors.

	In-patients		Out-patients		OPCS (45-65years)	
	Mean	SD	Mean	SD	Mean	SD
BMI (kg/m^2)	23.6	4.4	26.3	5.2	26.9	6.7
% fat	30.4	8.9	34.4	6.0	N/A	
BMI < 20 (%)	20		6		2.5	
BMI > 30 (%)	8		16		20	

This study suggests that the distribution of BMI among the out-patients was similar to that of the general population, although for the in-patients the distribution was skewed to lower BMI. However the data from the present study should not be extrapolated to other populations since the incidence of BMI < 20 kg/m^2 is reported to be as high as 37% (McWhirter & Pennington 1994) in other patient groups. Finally, a history of anorexia does not necessarily relate to BMI; possibly because of the subjectivity of reporting or differences in the timing and duration of symptoms.

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Survival of patients with metastatic colorectal cancer correlates with indices reflecting the inflammatory response, but not with weight loss. By DAVID B. GOUGH[1], KENNETH C. FEARON[2], DAVID C. CARTER[2], *Departments of Surgery, [1]University of Aberdeen, Aberdeen AB9 2ZD, and [2]Edinburgh University, Edinburgh EH3 9YW*

It is well established that malnutrition and metabolic dysfunction adveresely affect survival of patients with cancer. It is unclear whether these disturbances directly influence outcome or simply reflect more important underlying inflammatory processes. The aim of the present study was to assess the relationship between indices of the inflammatory response (serum C-reactive protein (CRP), serum albumin, CRP/albumin ratio, leucocyte count (WCC), peripheral blood mononuclear cell (PBMC) tumour necrosis factor (TNF) production) and weight loss, with survival duration in patients with metastatic colorectal cancer.

The study was performed in thirteen out-patients with metastatic colorectal cancer. Percentage weight loss over the previous 6 months (assessed by questionnaire and patient records), routine haematology, serum acute-phase proteins (CRP, albumin), spontaneous PBMC TNF production (WEHI cell line bioassay) and survival from the day of study were assessed.

Median values for survival (144, range 5-679 d), serum albumin (31, range 18-42 g/l), CRP (54, range 8-180 mg/l), CRP/albumin (2.1, range 0.26-7.2), WCC (7.6, range 2-14.8 $x10^9$/l), weight loss (9, range 3-25%), and spontaneous PBMC TNF production (119, range 16-2100 pg/ml) were variable among the group and showed evidence of an inflammatory response, weight loss and short survival.

Duration of survival correlated (Spearman correlation) with indices reflecting the inflammatory and acute-phase response e.g. CRP (r -0.69, P=0.006), albumin (r 0.66, P=0.011), CRP/albumin (r -0.76, P=0.002), WCC (r -0.67, P=0.012), PBMC TNF production (r -0.53, P<0.05) but not with weight loss (r 0.15, P=0.61).

Production of inflammatory mediators e.g. TNF and the inflammatory response in patients with cancer is associated with decreased survival. While weight loss may occur in patients with cancer, possibly in response to accompanying inflammatory processes, it was not associated with reduced duration of survival in this study.

Continuous enteral feeding impairs gallbladder contractility in newborn infants. By G. JAWAHEER[1], N.J. SHAW[1], D.A. LLOYD[2] and A. PIERRO[3], *[1]Fazakerley Hospital, Liverpool L9 7AL, [2]Alder Hey Children's Hospital, Liverpool L12 2AP and [3]Great Ormond Street Hospital for Children, London WC1N 1EH*

Cholestasis is the major complication of parenteral nutrition in infancy. It has been shown that parenteral nutrition impairs gallbladder contraction in newborn infants (Jawaheer *et al.* 1995). This may be due to the continuous delivery of nutrients rather than to diet composition or route of administration.

The aim of the present study was to compare the effects of bolus enteral feeding (BEF) with continuous enteral feeding (CEF) on gallbladder contractility in neonates.

Eight stable infants receiving BEF for at least 3 d were studied. The median gestational age was 32.5 (range 28-37)weeks; the median postnatal age was 17.5 (range 4-46)d; the median weight was 1.4 (range 1.2-2.4)kg. During the study period, a baseline BEF (20 ml/kg) was given, followed by 3d of CEF, after which BEF (20 ml/kg) was resumed. Gallbladder volume was measured by ultrasound, using the ellipsoid method, during the six consecutive time points shown in the Table. At each time point, measurements were made every 15 min to detect the maximal gallbladder contraction.

Results are expressed as median and range. Only preprandial volume for BEF and first measured volume for CEF are shown in the Table.

	Gallbladder volume (mm^3)	Gallbladder contraction (%)
Baseline BEF	206.9 (99.9 - 379.4)	57.3 (40.6 - 74.1)
Day 2 CEF	325.3**(122.7 - 496.3)	2.7 ** (0.0 - 14.9)
Day 3 CEF	379.5**(190.9 - 1137.9)	5.5 ** (0.0 - 8.4)
First resumed BEF	379.5**(190.9 - 1137.9)	45.4 (26.4 - 63.8)
Day 2 BEF	256.6* (115.2 - 1174.3)	52.6 (39.1 - 70.9)
Day 4 BEF	173.9 (118.7 - 755.1)	62.6 (46.9 - 90.7)

Median values were significantly different from baseline BEF: * $p < 0.025$, ** $p < 0.01$ (Wilcoxon test).

We conclude that: (1) in newborn infants, continuous enteral feeding impairs galbladder contractility and leads to an enlarged gallbladder; (2) gallbladder contraction is observed immediately after the resumption of bolus enteral feeds and gallbladder volume returns to baseline after 4 d; (3) the mode of feeding has important bearings on the motility of the extrahepatic biliary tree.

Jawaheer G., Pierro A., Lloyd D.A. & Shaw N.J., (1995). *Archives of Disease in Childhood* **72**; F200-F202.

Malnutrition in a Scottish children's hospital. By W.H.HENDRIKSE, J.J.REILLY and L.T.WEAVER, *Department of Human Nutrition, University of Glasgow and Royal Hospital for Sick Children, Yorkhill, Glasgow G3 8SJ*

Malnutrition may retard growth, increase the risk of infection and lengthen the duration of hospital admission, particularly in children with chronic disease. Several surveys have shown a significant but unrecognized high prevalence of undernutrition in adults admitted to hospital (Lennard-Jones, 1992; McWhirter & Pennington, 1994). However there have been no previous studies of Scottish children in hospital. We aimed to measure the body weight, height, mid upper arm circumference (MUAC), triceps (TSFT) and subscapular (SSFT) skin fold thicknesses of a sample of children seen at the Royal Hospital for Sick Children, Glasgow.

We studied 226 children (of which 93% were Caucasian) aged 7 months to 16 years (140 male, 86 female) admitted to the medical or surgical wards or out-patient clinics during a period of 9 weeks in the winter of 1994-5. Body weight was measured using an electronic balance, height with a stadiometer, MUAC using a tape, and TSFT and SSFT with skin callipers. We compared our results with published standards (Tanner *et al.* 1966).

The prevalence of undernutrition was around 15%, 16% of children were underweight-for-age (<5th centile), 15% were stunted (<5th centile height-for-age) and 8% were wasted (<80% weight-for-height). Only one third of these malnourished children were known to or referred to the dietitians. Of the children, 16% were moderately undernourished or at risk of becoming so (between -1SD and -2SD for both weight-for-height and height-for-age) and 19% had a weight-for-height between 80% and 90% of standards. MUAC correlated significantly with BMI (weight/height^2) ($P < 0.0001$, r 0.77).

Children with diseases of the digestive system (inflammatory bowel disease, cystic fibrosis, coeliac disease) were most at risk of undernutrition. When those with these diseases were omitted from the analyses, 13% of the remaining children were <5th centile weight-for-age and 12% were <5th centile height-for-age.

Our findings are comparable with surveys of patients in children's hospitals elsewhere (Merritt & Suskind, 1979; Parsons *et al*, 1980; Moy *et al*, 1990). A significant proportion of children admitted to hospital are malnourished. Body weight and height should be measured and plotted on appropriate growth standard charts, or MUAC used to identify children with low BMI. This study, in common with others, indicates that undernutrition in children in hospital remains largely unrecognized by the medical and nursing staff caring for them.

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Merritt, R. J. & Suskind, R. M. (1979). *American Journal of Clinical Nutrition* **32**, 1320-1325.
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Tanner, J.M., Whitehouse, R.H., Takaishi, M. (1966). *Archives of Disease in Childhood* **41**, 454-471.

An open prospective randomized comparison of a newly available high-energy enteral feed, with a conventional formula designed for children 1-6 years. By BRIDGET LAMBERT[1], ANITA MACDONALD[1] and IAN W BOOTH[2], *[1]Birmingham Children's Hospital NHS Trust, Ladywood Middleway, Birmingham B16 8ET and [2]Institute of Child Health, Francis Road, Ladywood Birmingham B16 8ET.*

Until recently, there has been no sterile ready-to-use enteral feed providing 6.3 kJ/ml (1.5 kcal/ml) available for children aged 1-6 years and/or 8-20 kg body weight. Paediatric feeds of 4.2 kJ/ml (1 kcal/ml) have been available and in use for several years. However, a higher energy density enteral feed may be desirable for those children with high energy requirements or who cannot tolerate large feed volumes. Current dietetic practice is to increase the energy density of a 4.2 kJ/ml feed by the addition of a glucose polymer and fat emulsion, but this may be inaccurate and it increases the risk of bacterial contamination.

In a controlled study, twenty children aged 1-6 years, and/or 8-20 kg body weight requiring enteral feeding were randomized to receive either a newly available high-energy paediatric formula (Nutrition Paediatric Energy Plus, (NPEP), Nutricia Clinical Care) or a conventional paediatric formula (Nutrison Paediatric (NPC), Nutricia Clinical Care) with added energy supplements (Maxijul, SHS and Calogen, SHS). Both feeds provided 6/3 kJ ml (1.5 kcal/ml).

Feeds provided a mean 68 (range 49-99)% of the estimated average requirement (Department of Health, 1991) for energy for children on the NPEP and 63(range 37-103)% for those receiving the NPC. Mean follow-up was 69 days (range 15-84d). Children grew and gained weight throughout the study on both feeds, and there was no significant differences between the two groups.

Change in anthropometric measurements between the start and end of study

	NEP (n 10) Mean Range	NPC (n 10) Mean Range
Weight kg	0.93 0.1-1.4	0.9 0.2 - 2.3
Height cm	2.03 0-3.5	1.95 0-5
MUAC cm	1.04 0.3-2.1	0.72 0-1.5

MUAC- mid upper arm circumference

Haematological and biochemical measurements remained within normal ranges and there were no differences in tolerance between the two formulas.

Nutritional intake was significantly better for some nutrients including Ca ($P = 0.0042$), Se ($P = 0.01$), vitamin A ($P = 0.012$), vitamin D ($p = 0.014$), and vitamin C ($P = 0.037$) in the NPEP group. There were no significant differences in Fe and protein intake between the two formulas.

Nutrison Paediatric Energy Plus is well tolerated and promotes growth. Its concentrated nutrient density makes it an ideal feed for young children unable to tolerate large fluid volumes, and those on overnight feeding regimens with known poor dietary intakes during the day.

Department of Health (1991). Dietary Reference Values for Food Energy and Nutrient for the United Kingdom, Report on Health and Social Subjects No. 41. London: H.M. Stationery Office.

Can nurses identify nutritionally depleted elderly patients? By A.D. Carver, *Senior Dietitian, Fife Healthcare NHS Trust, Stratheden Hospital, Cupar KY15 5RR*

In clinical practice quick methods are needed by nursing staff to identify patients who are malnourished or at risk of becoming so, in order that appropriate referrals to dietitians can be made and interventions can be started early. These methods ideally should utilize readily available information and observation rather than detailed histories, measurements, biochemistry and haematology.

In the present study, as part of the process of development and validation of a screening tool which is designed to be used when admitting a patient to hospital, the nurse was asked to categorize the patient as 'very thin', 'thin', 'okay', 'overweight' or 'very overweight'. Assessments by nurses on 102 patients (mean age 82.3 years, 80% female) were compared with BMI (calculated from estimated height derived from knee height (Chumlea et al 1985)) and with a 'depletion index' based on BMI, triceps skinfold (TSF) thickness and mid upper arm muscle circumference (MAMC) (McWhirter & Pennington 1994).

	Nurses' subjective rating				
BMI	'very thin'	'thin'	'okay'	'overweight'	'very overweight'
< 15.0	6	1			
15.0-19.9	2	13	8		
20.0-24.9		4	34	2	
25.0-29.9			10	15	
> 30.0				7	1

	Nurses' subjective rating				
Depletion index	'very thin'	'thin'	'okay'	'overweight'	'very overweight'
no depletion	0	9	49	24	1
mild	2	5	3		
moderate	1	3			
severe	5	1			

In this study, using nurse's observations of patients, rather than measurements of height, weight (and calculation of BMI), TSF and mid arm circumference (and calculation of MAMC) to identify nutritionally depleted patients would have resulted in only 3/103 false negatives (nurse rating 'okay' but evidence of mild depletion) and 9/103 false positive referrals (nurse rating 'thin' but no evidence of depletion). The three false negatives had a mean BMI of 18.5 and low TSF rather than low MAMC.

These findings indicate that this subjective rating scale will form a useful part of a screening tool which looks at appetite, weight loss, eating difficulties and other risk factors for poor intake in patients.

Chumlea, W.C., Roche A.F., & Steinbaugh M.L. (1985). *Journal of the American Geriatric Society* **33**, 116-120.

McWhirter, J.P. & Pennington, C.R. (1994). *British Medical Journal* **308**, 945-948.

Nutritional assessment and status of liver transplant candidates. By HELENA S. JACKSON [1], V. CLAIRE WICKS[2], GEOFF FORBES[2] and ROGER WILLIAMS[2], *[1]Department of Dietetics, King's College Hospital, London SE5 9RS, [2]Institute of Liver Studies, King's College Hospital, London SE5 9RS*

Orthotopic liver transplantation has become an established form of treatment for patients with advanced chronic liver disease. Malnutrition has been a common finding in such patients (DiCecco *et al.* 1989) and may contribute to disease-related mortality, increase perioperative morbidity and mortality and delay postsurgical recovery and discharge from hospital (Pikul *et al.* 1994).

The present study aimed to determine the nutritional status of forty-one patients, twenty-one female, twenty male, mean age 51 (range 17-69) years, with chronic liver disease at the time of acceptance onto the UK liver transplant waiting list between February and July 1995. Main indications for transplant were viral hepatitis (*n* 14), primary biliary cirrhosis (*n* 12), alcoholic liver disease (*n* 7), primary sclerosing cholangitis (*n* 2), cryptogenic cirrhosis (*n* 2) and other causes (*n* 4).

Dietary intakes of energy and protein were estimated by a trained dietitian using the diet history method and analysed by Diet 2000 software. BMI (kg/m^2) was calculated and the presence of ascites noted. Upper-arm anthropometric measurements were compared with standard values. A triceps skinfold or mid-arm muscle circumference value below the 5th percentile for sex and age was considered to indicate inadequate fat and muscle stores respectively. Energy requirements were calculated from measured weights, using Schofield (Schofield *et al.* 1985) equations to estimate BMR, and adjusted with respect to activity level. Energy intake as a percentage of energy requirements was calculated. Relevant symptoms such as anorexia vomiting, nausea, diarrhoea and encephalopathy were noted.

There was a significant difference ($P < 0.01$) between the mean daily energy intake of 7339 kJ, and the mean daily energy requirement of 9121 kJ. Thirty-one (73%) patients eating less than 100% and eighteen (44%) patients eating less than 75% their estimated requirements for energy. Eight patients complained of nausea and/or vomiting, sixteen patients (39%) reported anorexia and fifteen (37%) had some degree of encephalopathy. Sixteen (39%) patients were considered to be malnourished on the basis of inadequate muscle and/or fat stores with one or more upper-arm anthropometric measurements below the 5th percentile. Three (7%) patients had a BMI of less than 20 (i.e. below an acceptable weight), however 56% of all patients had ascites.

These results appear to be consistent with previous reports of malnutrition as a common finding in patients before liver transplantation. Many of these patients may become further nutritionally compromised while waiting for their transplant operation due to an inability to meet their requirements for energy. Symptoms of anorexia, nausea, vomiting and encephalopathy may prevent patients improving their nutritional intake. Nutritional assessment at the time of acceptance on to the liver transplant waiting list would identify inadequate nutritional status and relevant risk factors, and facilitate early and appropriate dietetic intervention.

DiCecco, S.R., Wieners, E.J., Wiesner, R.H., Southorn, P.A., Plevak, D.J. & Krom, R.A.F. (1989). *Mayo Clinic Proceedings* **64**, 95-102.

Pikul, J., Sharpe, M.D., Lowndes, R. & Ghent, C.N. (1994). *Transplantation* **57**, 469-472.

Schofield, W.N., Schofield, C. & James, W.P.T. (1985). *Human Nutrition: Clinical Nutrition* **39C**(Suppl 1), 5-96.

Case report: the nutritional management of a man treated for head and neck cancer. By NICKY S. GILBERT AND HELEN F. PETLEY, *Department of Nutrition and Dietetics, The Royal Surrey County and St Luke's Hospitals Trust and The Nutrition and Food Safety Research Centre, University of Surrey, Guildford, GU2 5XH*

Malnutrition is a common feature of head and neck cancer. Patients are often malnourished at diagnosis and routine treatment with surgery and/or radiotherapy exacerbates this problem (Chencharick & Mossman, 1983). Artificial nutrition support is not routinely prescribed for all patients.

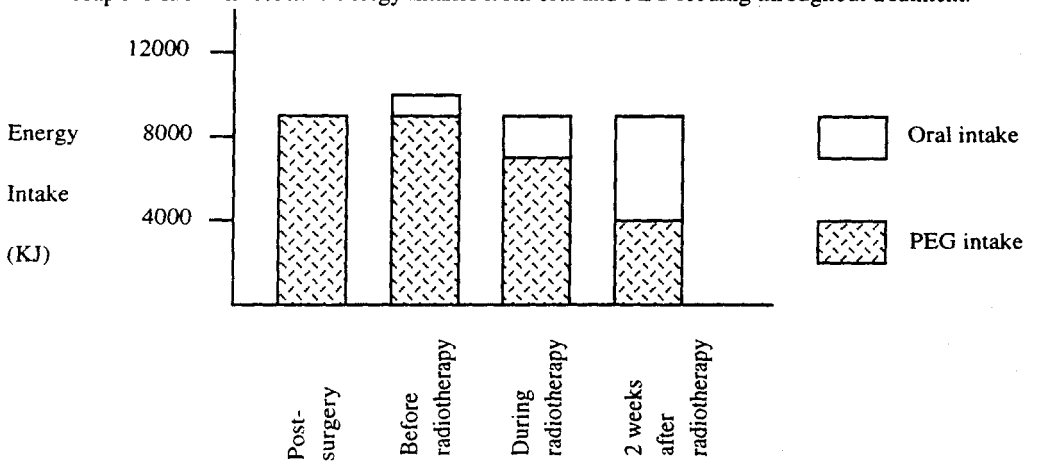
The present case study documents the importance of percutaneous endoscopic gastrostomy (PEG) feeding in meeting the nutritional requirements of a man treated for head and neck cancer.

Mr P. is a retired bursar with a long-standing history of smoking and drinking alcohol. He lives alone since recent separation from his wife. When oral cancer was diagnosed in March 1994 his body weight was stable and within the ideal range.

Soon after diagnosis, extensive oral and maxillo facial surgery was performed which included radical neck dissection, partial mandiblectomy and excision of the right floor of the mouth. During the operation a PEG was fitted and used 3 d later. Oral feeding was not possible until day 29 post-surgery due to the development of a fistula. Throughout this period nutrition was provided entirely via the PEG route by a complete feed delivering 9414 KJ and 90 g protein daily. PEG feeding continued at home for 4 weeks whilst oral intake increased slowly.

A 4-week period of radiotherapy commenced and due to the anticipated side-effects of sore mouth, lips and swollen tongue, the PEG again became the major feeding route. Four weeks after stopping radiotherapy, an oral diet of modified consistency fortified foods and supplements was considered adequate. Subsequently the PEG was removed.

Graph to show the relative energy intakes from oral and PEG feeding throughout treatment.



The PEG enabled Mr P. to meet his nutritional requirements. Throughout treatment he was of good morale and satisfied with his nutritional care. This case study demonstrates a role for PEG feeding of head and neck cancer patients scheduled for surgery and/or radiotherapy. This may have implications in reducing complications, improving treatment response and maintaining quality of life.

Chencharick, J.D. & Mossman, K.L. (1983). Cancer **51**, 811-815.

Pumps and stands limit mobility, but sleep is uninterrupted: home enteral feeding. By D. Carter C. Porrett, C. Wheatley, S. Foley, R. Martin, A. Micklewright, G. McHattie, J. Nightingale, L. Paul and M. Lee. *LITRE Working Party, 41, Adversane Road, Worthing, BN14 7QJ*

A total of 132 members of PINNT (Patients on Intravenous and Nasogastric Nutrition Therapy) who were receiving home enteral nutrition were sent a postal questionnaire and seventy-one (54%) responded (twenty-seven received nasogastric tube feeds, forty-one gastrostomy feeds and three jejunostomy feeds). They were asked about their feeding tube, pump, infusion stand, delivery service and holiday arrangements.

Fifteen (21%) said their feeding tube often blocked. Eleven (40%) of those feeding with a nasogastric tube re-passed the tube each night (four re-passed the same tube).

Most (*n*41;58%) were using a fully ambulatory pump. The majority (*n*46; 65%) did not have their pumps regularly serviced, although twenty-one (30%) had, in the past, needed to have their pump repaired. Most felt their pump was reliable (*n*58; 82%) and easy to use (*n*66; 93%), with a good alarm system (*n*52;73%).

Transportation of equipment was a problem, only forty-two (59%) said their pump and nineteen (34%) said the infusion stand was easy to carry upstairs. Forty (56%) said the pump liquid crystal light display was very bright but only five (7%) were kept awake by this, a further three (4%) were kept awake by the noise of the pump.

Thirty-six (51%) had a delivery service of enteral products, of these twenty-nine (81%) said supplies came on time, and twenty-six (72%) said supplies were always complete. Only fifteen (21%) had a clinical waste collection.

Although most (*n*57;80%) had taken a holiday forty-eight (68%) were apprehensive about taking one, thirty two (45%) due to worries about transportation of feed and/or equipment and twenty-two (31%) due to fears about illness. Despite this fifteen had travelled outside the UK for their holiday.

Most patients on home enteral nutrition are happy with their service and equipment, however lighter stands and pumps would be an advantage and may reduce the fear of going on holiday.

Development of a nutritional assessment tool, highlighting practical considerations. By Katrina Hamilton and Jayne Reeves. *Leicestershire Nutrition and Dietetic Service, Fosse Health Trust, Leicester, LE5 0TD.*

Documentation about each patient's nutritional status should be mandatory in medical and nursing admission records (Lennard-Jones, 1992).

It was recognized that a nutritional assessment tool was required, initially for hospital use. The aim was to raise nutritional awareness at ward level and to prompt early, appropriate referral of patients at risk of malnutrition to the dietetic service. This proactive approach would help to reduce the incidence of malnutrition and its associated conditions, in particular, pressure sores and poor wound healing.

Various existing screening tools were reviewed by dietitians and nursing staff. Specific criteria were set to produce a tool acceptable for use by Leicestershire nursing staff. These included: (1) quick to use, (2) easy to understand, (3) user friendly, (4) familiar layout, (5) guidelines for use.

LEICESTERSHIRE NUTRITION & DIETETIC SERVICES

NUTRITIONAL ASSESSMENT TOOL (PILOT)

BODYWEIGHT FOR HEIGHT		ABILITY TO EAT	
Acceptable	0	Ability to eat independently	0
Overweight	2	Ill-fitting dentures/chewing problems	1
Underweight	3	Swallowing problems	3
Assess supplement, weight loss	3	Needs to be fed	4
Severely underweight/obese	5	Complete dysphagia	5
SKIN TYPE		**SYMPTOMS**	
Healthy	0	Nausea	2
Dry and flaky	2	Vomiting	2
Oedematous	3	Constipation	2
Poor wound healing	4	Diarrhoea	2
Pressure sore - all grades	5		
APPETITE AND DIETARY INTAKE		**PSYCHOLOGICAL STATE**	
Normal appetite	0	Fully orientated	0
Reduced appetite	2	Confused	2
On special diet	2	Depressed, anxious, apathetic	2
e.g. supplements, diabetic etc.			
No appetite	4		
Will take/eat fluids for 7 days or more	5		
		AGE	
		If over 65 years add 2 to score	
		TOTAL ON ADMISSION	

- If score is greater than 10 - Refer to the dietitian.
- Remember this is only a tool to assist in assessment.
- If in any doubt about the score, look at your patient and use your professional judgement.

GUIDELINES FOR USE

NUTRITIONAL SCORE

Ward =

DATE	NUTRITIONAL SCORE	DIETETIC REFERRAL ✓ OR X

ANY QUERIES - CONTACT YOUR DIETETIC DEPARTMENT

The tool was piloted on two adult medical and one adult surgical ward (Glenfield Hospital) and three adult medical wards (Leicester Royal Infirmary) for a 1-3 month period.

Feedback from the nursing staff was extremely positive e.g. "quick and easy to use in view of its similar layout to the pressure sore risk assessment tool used countywide" i.e. Waterlow, "Reminds staff to think of nutrition even when busy".

Comments made by dietitians, specialist nurses and ward nursing staff included: (1) The use of BMI, rather than eyeball assessment, as an indication of nutritional status was to be encouraged in those areas where routine weight and height measurements were documented. (2) The use of professional judgement was vital as the scoring tool only acts as a guide.

Further adaptations of the tool are currently underway to ensure its suitability in different settings. It is hoped to continually evaluate and improve the form and to monitor its effect of dietetic resources. The ultimate aim is to implement the tool Leicestershire-wide to include acute teaching hospitals, community hospitals and non-hospital community locations.

In conclusion, it is apparent that there is no ideal nutritional assessment tool available. However , this particular tool has proved successful in Leicestershire increasing nutritional awareness and encouraging proactive referrals to the nutrition and dietetic service.

Lennard-Jones, J.E. (1992). *A Positive Approach to Nutrition as Treatment.* London: Kings Fund Centre
Waterlow, J. (1985). *A risk assessment card. Nursing Times* **89**, 27, 49-51.

A comparison of pre-operative percutaneous endoscopic gastrostomy feeding with standard management in patients undergoing major head and neck surgery for cancer.

By E. WOOLLEY[1], J. HUMPHREYS,[2] J. EDINGTON[2] and M. LOMBARD[1] . [1] *Walton Hospital, Rice Lane, Liverpool L9 1AE and* [2]*Abbott Laboratories, Abbott House, Norden Road, Maidenhead SL6 4XE.*

Patients with head-and-neck cancer undergoing major surgery are difficult to manage nutritionally as they are often unable to eat both before and after surgery. Tube-feeding via percutaneous endoscopic gastrostomy (PEG) may help to prevent a decline in nutritional status before surgery and improve rate of recovery after surgery. We have compared the efficacy and safety of peri-operative feeding via PEG tube with standard hospital care in patients requiring head-and-neck surgery. At 2-4 weeks before surgery patients with oral cancer were randomised to either PEG feeding with a combination of a fibre-containing enteral feed and a high energy feed (Jevity® and Ensure Plus® respectively, Abbott Laboratories), or standard care (dietary advice). PEG feeding continued until the day before surgery and recommenced immediately after surgery. Control patients received dietary advice before surgery, and were fed via nasogastric tube as required in the post-operative period. N balance studies were conducted at 1, 5 and 10 days after surgery. BMI, anthropometric measurements (triceps skinfold thickness, mid-arm circumference, mid-arm muscle circumference) serum albumin, prealbumin, haemoglobin, packed cell volume and a full blood count were measured at entry, 1 week before surgery, and at 1, 5, 10 and 28-35 d after surgery. Dietary intake (2 d) was recorded at baseline, 1 week before surgery and at the final visit.

Eight patients in the PEG group and nine patients in the control group completed the study. Patients in the PEG group maintained their body weight over the course of the feeding period whereas in the control group body weight went down in the 10 days immediately following surgery. In both groups of patients N balance was negative on Day 1 post surgery (-10.6 g, PEG group; -7.4 g, control group). However at day 10 post surgery N balance was positive in the PEG group but negative in the control group (3.0 g, PEG group; -1.06 g, control group). In addition, although prealbumin fell in both groups in the 5 d immediately after surgery, in the PEG group prealbumin had returned to pre-surgery levels by day 10, in the control group prealbumin was still below pre-surgery levels at both day 10 and day 28. We conclude that PEG feeding immediately before and after surgery helps to maintain body weight and nutritional status in patients undergoing major head-and-neck surgery.

Nutritional problems following stroke: assessment and clinical implications.

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Deterioration in nutritional status, dehydration and an increased morbidity and mortality have been associated with the presence of dysphagia and other eating problems resulting from acute stroke (Axelsson *et al.* 1984; Barer *et al.* 1989; O'Neil *et al.* 1992). The aim of the present study was to develop a method of assessing eating disability i.e. total functional impairment in patients taking food orally, with assistance.

An ordinal scaled assessment instrument was developed for use in informal settings. Eating problems resulting from impaired posture, arm movement, communication, lip closure, chewing, swallowing, attention, vision and perception were defined and graded according to the severity with which they impaired food ingestion, and to the level of dependency on meal time assistance. Scores ranging from 0 (no problem) to 3 (severe problem or dependency) were assigned to each problem. A summed index derived from adding scores within each problem category gave an overall measure of eating disability (maximum score 18). Pilot testing of the instrument established acceptable kappa values of > 0.7 for inter-rater reliability and Spearman's coefficients of > 0.85 for test - retest reliability on each scale item and summed index. Determination of Cronbach's coefficient α at a value of 0.81 confirmed the high internal consistency of the instrument.

In seventy-five patients who were stable on day 8 following acute stroke, predictive validity of the instrument was tested by comparing eating disability scores (range 2 - 16) with 24 h energy and protein intakes derived from weighing food. Significant, strong, negative correlations were found between 24 h energy and protein intakes *v.* eating disability scores (Spearmans rho - 0.867, $P < 0.001$; - 0.634, $P < 0.001$ respectively). A multiple regression analysis identified three independent variables which contributed to the overall variance (r^2) for energy consumption. These were impaired arm movement, lip closure and dysphagia (cumulative contribution to r^2 0.635). Impaired arm movement alone was predictive of protein consumption (r^2 0.414).

A discriminant function analysis was performed to identify independent variables capable of predicting those 24 h energy intakes which were only 30-50% of estimated average requirements (Department of Health 1991). Impaired arm movement, lip closure and chewing were significant predictors at these levels and, in conjunction with dysphagia, were predictive of energy intakes which were only 20-29% of estimated average requirements.

The above findings indicate that, in an informal setting increasing eating disability is associated with diminishing food intake following acute stroke. Patients with eating disability scores > 10 and those who have sustained impaired arm movement, lip closure, chewing or swallowing may be unable to maintain an adequate intake of nutrients and thus require nutritional support. Further longitudinal studies are necessary to confirm this.

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Home gastrostomy feeding in children and the role of a nutrition nurse. By GILLIAN ABEL[1], SUSAN HAMPSHAW[2], MARK D. STRINGER[3], JOHN M. BECK[3], and JOHN W.L. PUNTIS[4]. *Departments of [1]Paediatrics, [2]Medical Audit and [3]Paediatric Surgery, the General Infirmary at Leeds, and [4]Division of Paediatrics, University of Leeds, Clarendon Wing, Belmont Grove, Leeds LS2 9NS*

We have conducted a prospective study of home gastrostomy patients in order: (1) to define the role of a paediatric nutrition nurse specialist (PNNS) in supporting families; (2) to examine the performance of one particular gastrostomy device, the MIC-KEY® skin level gastrostomy tube (Ballard Medical Products, Draper, Utah, USA).

Prospective data were collected for devices in use for a total number of days equivalent to 8.5 years, in thirty-one patients, mean age 5.8 (range 0.25 - 14) years. A total of fifty-six MIC-KEY® skin level devices were inserted, and twenty-five removed. The majority of children had disorders of the central nervous system: cerebral palsy (n # 13), degenerative conditions (n # 4), and trauma (n # 4), whilst the rest had gastrointestinal (n # 7), or metabolic disease (n # 3).

The role of the PNNS before gastrostomy was: (1) to demonstrate the device to the child and family; (2) to plan for discharge home; (3) to perform anthropometry so that nutritional goals could be set. A MIC-KEY® skin level gastrostomy tube was inserted into an established stoma, most commonly by the PNNS (n # 20), or by members of the surgical team (n # 31). Thirty-three MIC-KEY® devices were inserted with the child on the ward, ten at home, and only thirteen in the operating theatre. Post insertion, the role of the PNNS was: (1) to teach care of the gastrostomy and safe delivery of feed; (2) to contact health care staff in the community; (3) to arrange continuing support to the family (including home and school visits), and supply of equipment. The most common reasons for further involvement of the PNNS were leakage from the valve (n # 12), wound granulation (n # 9), burst balloon (n # 8), and accidental removal (n # 6).

We conclude that the MIC-KEY® skin level gastrostomy tube is a reliable method for long-term nutritional support in the child at home with chronic illness: the PNNS provides an important link between hospital and community (thereby facilitating home care), improves the quality of patient care, and alleviates pressures on the surgical team.

Small but all that's needed. 9Ch Freka percutaneous endoscopic gastrostomies (PEG) may last 2 years. By B.L. LITCHFIELD, J.M.D. NIGHTINGALE and B.J. RATHBONE, *Department of Gastroenterology, Leicester Royal Infirmary, Leicester LE1 5WW*

Seventy patients (thirty five women), median age 70 (range 31-100) years had a 9Ch Freka PEG inserted between 1st January 1991 and 30th June 1995. All were inserted via a 2-3 mm epigastric incision, no prophylactic antibiotics were given and no dressing covered the exit site. The number of PEG has been increasing (1 in 1991, 8 in 1992, 17 in 1993, 29 in 1994 and 15 for the first half of 1995). The reasons for PEG insertion and outcome are shown in the Table.

Reason for PEG	Inserted (*n* 70)	Deaths (*n* 37)	Stopped (*n* 10)	Continue (*n* 20)
Cerebrovascular disease	31	17	1	12
Motor neurone disease	13	9	0	3
Head injury/trauma	7	1	5	0
Pre-ENT surgery	6	3	2	1
Multiple sclerosis	5	1	0	4
HIV infection	3	3	0	0
Other	5	3	2	0

ENT, ear, nose and throat.

HIV, human immunodeficiency virus.

Three patients were lost to follow up.

Thirty seven (53%) patients died from non-PEG related illness after a medial 5 (range 1-68) weeks from insertion. Ten (14%) patients were able to resume an adequate oral diet and therefore stopped PEG feeding. Twenty one (30%) continue feeding, of these seven have had their PEG replaced after a median of 22 (range 2-30) months, all due to occlusion (two of these had epithelial overgrowth). There have been no reports of leakage or exit-site infection.

The insertion of a 9Ch PEG is a successful procedure that requires no antibiotic cover, local complications are rare, and the tube may function for 2 years. This study raises the question of whether it is ethically justifiable to use larger PEG tubes which may have more serious complications.

A caterers' perception of feeding patients in hospital. By P.C. MCGLONE, J.W.T. DICKERSON and G.J. DAVIES. *Nutrition Research Centre, South Bank University, 103 Borough Road, London SE1 OAA*

Malnutrition is still a problem in British hospitals (McWhirter & Pennington, 1994). The nurses' responsibility in the feeding of patients has changed since the Salmon Report (1966). However, the nurse is still the person who has 24 h contact with patients and therefore is most likely to notice if a patient's food intake declines (MacDonald, 1986). Tredger (1982) suggested that the feeding of patients is a team effort. Communication therefore, between the patients, ward staff and the catering department is important if patients are to receive the appropriate foods.

In the present study eighty questionnaires were completed by hospital caterers to ascertain who was involved in helping patients choose their food and receive the appropriate choices.

	Delivery of menu card (%)	Guidance for completion of menu card (%)	Request for special foods (%)	Distribution of food (%)
Nurse	35	35	32	57
Ward orderly	11	21	17	11
Ward orderly or nurse	28	-	39*	20
Dietitian	-	15	9	-

*Nurse or Dietitian

Of the caterers who responded, 85% indicated that guidance was available for patients when they completed their menu cards; 82% of the hospitals offered their menu cards in the English language only. Only three hospitals involved the interpreter in guiding patients with menu completion if they were unable to read English.

These findings suggest that caterers saw nurses as having rather more responsibility than orderlies for the delivery of menu cards and giving guidance for their completion, but they saw nurses as having a more major responsibility for the distribution of food. Nurses and dietitians shared in the responsibility for requesting special foods. It would seem that the communication between nurses and patients, and between nurses and catering staff is important if patients' nutritional needs are to be met.

The fact that only 18% of the responding hospitals offered menus in a language other than English, and that in only three hospitals was an interpreter present to give guidance to those who could not understand English, suggests that unsuitable food choices may be made by those whose native language is not English. This could lead to food wastage and a low food intake, and in some cases to interference with treatment.

The results from this investigation suggest the need for more research into the communication of ward staff with the catering department and the effects of this communication on the food intake of patients.

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The oxygen content of parenteral nutrition admixtures prepared by different methods. By PATRICK A. BALL[1] and MICHAEL I. BARNETT[2]. [1]*School of Pharmacy, University of Otago, Dunedin, New Zealand, and* [2]*School of Pharmacy, University of Wales, Cardiff CF1 3XF.*

There has been much interest in the effects of O_2 permeation through parenteral nutrition containers during storage. The aim of the present project was to investigate whether the method of preparation influenced the amount of dissolved O_2 present in the finished solutions.

Parenteral nutrition admixtures were prepared in a hospital clean room during normal working sessions, by five different well established methods, and transferred into multi-layer parenteral nutrition containers (Ultrastab®-Miramed SA). A final control group was also prepared by manual methods, inside an aseptic isolator which had been turned off and purged with N_2 until the O_2 concentration inside the work area was below the limits of detection. The finished solutions were then sampled into a clean vial and immediately measured by immersing an O_2 electrode (Check-Mate 90 Ciba-Corning) into the solution. (Control runs of the transfer method with water showed no measurable increase during the transfer process.)

Admixture	Method	n=	mean O_2 µmol/ml	S.D.
Paediatric 2in1 Mixture	Burette Method	5	0.40	0.03
	Automix Method	10	0.75	0.15
	Vacumat Method	10	0.35	0.03
Adult 3in1 Mixture	Manual Method	5	0.38	0.04
	Vacumat Method 1*	3	0.27	0.04
	Vacumat Method 2*	5	0.28	0.02
	Automix Method	10	0.67	0.20
	Air-Free Method	2	0.13	0.02

* Method 1 'Drain all containers' mode, Method 2, Dispensing by weight mode.

All methods differed significantly, $P<0.05$.

The table shows that the amount of dissolved O_2 found in the final admixture solution was affected by the preparation method used. Allwood et. al. (1992) have shown the effect of O_2 permeation into admixtures on storage. It has been suggested that the amount of O_2 introduced during compounding may be more important (Proot et. al. 1994) This work demonstrates that different preparation methods introduce considerable amounts of O_2, that the amounts introduced vary significantly between methods ($P<0.05$) and that the variation between individual solutions prepared by the same method can also be considerable.

Multi-layer containers certainly improve the stability of admixtures on long-term storage, but this work suggests that those preparing admixtures for extended storage will also need to address preparation methods.

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A simplified method for compounding glutamine-enriched total parenteral nutrition (TPN) mixtures. By GIL HARDY[1], DAVID WIGGINS[1], EDWARD HOLT[2] and TIM SIZER[3], [1]*Oxford Nutrition, P O Box 110, Oxon OX8 7FJ,* [2]*Pharmacy, Huddersfield Royal Infirmary HD3 3EA and* [3]*Pharmacy, Cheltenham General Hospital GL53 7AN*

Previous studies have reported stability of 25 g/l L-glutamine (GLN) solution in multilayer bags stored at 4° (see McElroy & Hardy, 1995). This allowed our Specials Manufacturing Unit to produce aseptically 1-litre bags containing 20-25 g GLN for compounding 3-litre TPN regimens. Acceptable stability of GLN-enriched 'All-in-One' (AIO) mixtures has facilitated valuable clinical studies (Griffiths, 1995).

However, GLN additions have complicated compounding procedures and are relatively expensive. We therefore investigated the feasibility of producing sterile GLN solutions as underfilled 3-litre bags to simplify GLN-AIO mixing for a Pharmacy Compounding Unit.

GLN solutions were prepared in new design 3-port 3-litre multilayer bags (GLN stability after 1 month storage at 4° is unaffected by container size). These GLN bags, with separate filling sets, were transported at 4° to the Compounding Unit and used to prepare two GLN-rich AIO mixtures:

A3 (with Aminoplex 24) provided 35 g GLN, 12.9 g N;

B3 (with Vamin 18) provided 20 g GLN, 12.8 g N.

Each mixture contained 8368 kj (2000 kcal) (50:50 carbohydrate: fat) and electrolytes. Bags were analysed at intervals for GLN, glutamate (GLU) and NH_3 (standard enzymatic methods), pH and particle size distribution (PSD) by Coulter Counter for emulsion stability, during 30 d storage at 4°.

GLN degradation was 3.68% at 21 d and 6.8% at 30 d in mixture A3; 4.4% at 21 d and 7.0% at 30 d in mixture B3. GLU was essentially unchanged: NH_3 increased (A3 to 2.9 mM and B3 to 1.69 mM at 30 d) but not above physiologically acceptable levels. pH increased slightly (A3: 6.53 - 6.58, B3: 5.85-5.87). Mixtures remained homogeneous (PSD > 95% at 2 um) after 30 d with no visible signs of emulsion creaming or cracking.

These preliminary findings demonstrate that > 95% GLN remains in both AIO mixtures after 21 d storage at 4°. NH_3 generation is tolerable at < 0.1 mM/d. Aseptic filling was no more difficult and no more expensive in the larger GLN bags allowing an overall product cost saving of approximately 10% plus an additional potential saving in pharmacy time from the simplified AIO compounding procedure. The new system allows preparation of stable AIO mixtures, incorporating up to 35 g GLN in approximately 2700 ml, for storage and use up to 21 d at 4° before clinical use.

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Assessment of compatibility of a Paediatric Trace Element injection in a range of total parenteral nutrition mixtures. By L. HINCHLIFFE[1], M.C. ALLWOOD[1], G. HARDY[2] and A. NUNN[3]. [1]*Medicines Research Unit, University of Derby, Kedleston Road, Derby DE22 1GB,* [2]*Oxford Nutrition Ltd, PO Box 110, Witney OX8 7FJ,* [3]*Royal Liverpool Children's Hospital, Eaton Road, Liverpool L12 2AP*

The procedures and results are described for a physical compatibility study when a Paediatric Trace Elements for Injection (PTE) solution (Lab. Aguettant, France) was tested with a range of total parenteral nutrition (TPN) mixtures, containing Vamin 9, Vaminolact (Pharmacia) or Primene (Clintec) as the amino acid source, suitable for use in children and neonates, utilizing the technique of scanning electron microscopy coupled with X-ray energy dispersive spectroscopy (SEM-EDS).

A series of lipid-free formulations suitable for a 4 kg infant, containing different amino acids, were compounded aseptically in 500 ml ethylvinylacetate bags, sealed, overwrapped and stored at 5°. The regimens provided the following requirements per kg body weight: 0.45 - 0.47 g N (dependent on amino acid source), 234kJ (56 kcal) glucose, 3 mmol Na, 2.5 mmol K, 1.0 mmol Ca, 0.5 mmol Mg, 0.5 mmol P (as glucose-1-phosphate) and 1 ml PTE. The formulations were provided as either standard (130 ml/kg) or low volume (60 ml/kg) mixtures. The contents of each bag were examined following filtration by SEM-EDS (Allwood & Greenwood, 1992) to detect physical incompatibilities and precipitates after 2 and 28 d storage at 5°. It should be noted that each storage period was followed by 24 h at ambient temperature to simulate administration conditions.

Precipitates in TPN mixtures are identified by observation of the filter surface and by the identification of elemental peaks within the spectra. In the present study the EDS spectra showed a variety of elemental peaks, however none appeared at levels indicative of precipitate formation as a consequence of any physical incompatibility in the TPN mixtures stored for 2 or 28 d. Examination of filter surfaces using the SEM showed only minor increases in the number of particulates on all the samples in comparison with the controls. Although a general increase in particulate number was noted with time, none of these particles showed evidence from the elemental analysis that they originated from the PTE.

It may therefore be concluded that the PTE and glucose-1-phosphate can be added to the TPN regimens described for neonates and small children. The results indicate that these solutions are physically compatible for a period of up to 28 d, when stored at 5°.

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Nutritional assessment and management of liver transplant patients. By O. BRADY [1], C. CORISH [2], S. SUGRUE [1] and J. HEGARTY [3], *[1] Department of Biological Sciences, Dublin Institute of Technology, Kevin St, Dublin 8, [2] Department of Nutrition and Dietetics and [3]Liver Unit, St. Vincent's Hospital, Dublin 4, Republic of Ireland*

Malnutrition is a common finding in patients who are awaiting liver transplantation (Shronts *et al.*1987). Poor pre-operative nutritional status increases morbidity and mortality peri-operatively (Porayko *et al.* 1991). The interpretation of nutritional assessment indices is impeded by the difficulties in separating the effects of liver dysfunction from disturbances secondary to nutritional deficiencies.

The aim of the present study was to investigate the pre-operative and post-operative nutritional status and management of the first nineteen patients successfully transplanted in the Irish National Liver Transplant Unit. The following variables were used to assess nutritional status: body weight, upper arm anthropometry, serum albumin, international normalized ratio (INR), total lymphocyte count (TLC) and dietary analysis.

Pre-transplant (Pre-TX) body weight was dismissed as a variable for assessment of nutritional status; 89% of patients were heavier than 100% ideal body weight (IBW) but this was contrary to other nutritional variables and due to the presence of ascites and/or peripheral oedema; 47% were mildly malnourished and 21% severely malnourished, as defined by upper arm anthropometry. All patients had low serum albumin and TLC, and elevated INR. Reduction in upper arm anthropometry was not correlated positively with falling serum albumin (normal range 35-50g/l) and TLC (normal range 1.2-1.5 x 10^9/l), reinforcing the difficulty in distinguishing liver function from nutritional status in this group of patients.

	Pre-TX.		Post-TX.		Current	
	Mean	SD	Mean	SD	Mean	SD
MAMC(mm)	224	25.9	206	34.9	195	25.0
TST(mm)	14.1	6.3	12.43	6.1	24.9	11.7
ALBUMIN(g/l)	29.4	4.7	31.7	4.45	39.8	4.08
TLC(10^9/l)	0.68	0.46	0.95	0.7	NOT RECORDED	
INR	1.93	1.16	1.29	0.61	1.16	0.38

Post-transplant (Post-TX) anthropometric measurements deteriorated but serum albumin and TLC increased, reflecting improved liver function. Initiation of feeding occurred between 1 and 4 d post-operatively. Maintenance of lean body mass is associated with the initiation of feeding within 18 h of transplant (Wicks *et al.* 1994). In this group, 62% of patients received enteral nutrition and 38%, parenteral. Those enterally fed reached full oral diet earlier than those parenterally fed (mean 12 : 18 d). Mean length of hospital stay in enterally fed patients was 53% that of patients parenterally fed.

Recent assessment of nutritional status revealed that 58% of patients were of normal weight, 32% were overweight and 10% underweight. However, 74% had fat stores greater than the 50th percentile and 26% greater than the 95th percentile; 67% of the overweight patients had reported dietary intakes (measured by three day dietary record) exceeding their calculated energy expenditure.

In conclusion, there is need for more accurate indices to assess nutritional status in liver transplant patients. Measurement of upper arm anthropometry and observing changes over time are the most reliable, easily obtainable indicators at present. Emphasis should be placed on early referral for nutritional support. Post-operative feeding should be initiated as early as possible in order to minimise the catabolic effects of surgery. Enteral nutrition should be used in preference to parenteral.

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Overnight percutaneous endoscopic gastrostomy (PEG) feeding using an elemental formula in adolescents and adults with cystic fibrosis. By F.ASHWORTH[1], A.McALWEENIE[1], S.WILLIAMS[3], M. HODSON[2], S.POOLE[1] and D.WESTABY[3], [1]*Department of Nutrition and Dietetics,* [2]*Department of Cystic Fibrosis, Royal Brompton Hospital, London SW3 6NP* [3] *Department of Gastroenterology, Charing Cross Hospital, London W6*

Adolescents and adults with cystic fibrosis (CF) who have recurrent pulmonary exacerbations are often severely malnourished (Shepherd *et al.* 1984). Dyspnoea, poor appetite, foul-tasting sputum, maldigestion due to pancreatic insufficiency and an increased energy expenditure, can contribute to the generally poor nutritional status of this group of patients (Schwachman, 1975; Buchdahl *et al.* 1988).

At Royal Brompton Hospital we used overnight feeding via PEG in fifty-three adolescents and adults with CF (fourteen males, thirty-nine females, median age 21 (range 11 - 42) years between 1988 and 1994, to help meet their increased energy requirements (120-150% of estimated average requirement, Department of Health, 1991), improve their nutritional status (BMI) and help recovery from pulmonary exacerbations. A number of these patients required improvement in their nutritional status in order to be accepted for lung transplantation. We retrospectively examined case notes and found that the median BMI pre-PEG improved from 14.8 (range 10 - 17.9)kg/m^2, to 17 (range 12.9 - 21.1)kg/m^2 at 6 months post-PEG, and to 17.15 (range 14 - 21.5)kg/m^2 at 12 months, showing that there was a highly significant improvement in nutritional status (P=0.0001, ANOVA). Similarly median weight increased from 36 (range 22 - 48)kg before supplementary feeding to 40 (range 23.9 - 61)kg at 6 months and 42.9 (range 22.9 - 61.2)kg at 12 months (P=0.0001). Lung function was measured as a marker of clinical status using forced expired volume in 1s (FEV_1) and forced vital capacity (FVC). The median pre-PEG FEV_1 /FVC was 0.76/0.88 litres, which did not change significantly after 12 months of supplementary feeding (0.86/0.88 litres). The mean percentage predicted FEV_1 pre PEG was 21 and the mean percentage predicted FVC was 33, indicating that these patients had severe lung disease.

The majority of patients (89%) used a modular elemental feed (Elemental O28, Liquigen (SHS,UK) and Polycose, (Abbott)) which was tailored to the patients' individual requirement and tolerance and did not require the use of pancreatic enzyme supplements for digestion. Fourteen of these patients changed to a nutritionally complete elemental formula (Emsogen, SHS, UK) in 1993, five patients were on whole protein feeds and one on a semi-elemental feed, both of which require pancreatic enzymes for digestion. The feeds provided a median energy content of 6109 kJ which is approximately 50% of their estimated daily energy requirement (range 3096-8368 kJ). There were no major complications, although six experienced leakage, three experienced mild infection at the stoma site and six had to have their PEG replaced due to wear and tear.

At Royal Brompton Hospital we have shown that supplementary gastrostomy feeding using an elemental formula is a safe, flexible and well-tolerated means of significantly improving the nutritional status of CF patients with severe pulmonary disease.

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Cross-contamination of enteral feeding systems via the luer connector: a preliminary study. By A. McKILLOP-SMITH[1], A. ANDERTON[2], J. McKINLAY[1] and L. McROBBIE[1], [1] *Aberdeen Royal Infirmary, Foresterhill, Aberdeen AB9 2ZB and* [2]*Environmental Health Division, University of Strathclyde, Glasgow G4 0NG*

Recent studies have demonstrated endogenous contamination of enteral tube feeds (Payne-James *et al.* 1992; McKinlay *et al.* 1995) with feed samples collected from the distal end of the giving set containing $> 10^5$ colony forming units/ml. The purpose of the present study was to investigate whether handling of the luer connectors between the giving sets and enteral feeding tubes may result in micro-organisms being transferred between patients' feeding systems.

Ten patients in the intensive therapy unit receiving 1000-2000 ml sterile, undiluted, whole-protein feed over 24 h from 1000ml prefilled containers (Nutrison Steriflo, Cow and Gate Nutricia Ltd) were included in the study. One giving set was used over 24 h for each patient. Patient systems were assembled by nurses on the ITU and simultaneously a simulated patient system (1000 ml prefilled container and giving set attached to an enteral feeding tube suspended and taped into the catheter of a sterile urine bag used to collect the feed) was assembled by the researcher. Each nurse was instructed that whenever any handling procedures were carried out on the luer connector of the patient's system they should immediately be repeated on the simulated system. Samples of feed from the nutrient containers and the distal ends of giving sets were sent for microbiological analysis immediately after removal from the patient. Samples from the simulated system were sent simultaneously, the urine bag being sampled at the same time as the giving set. Control experiments demonstrated that there were no micro-organisms in the unopened feed containers and that none were introduced during the feed sampling procedure or during the initial assembly of the simulated systems.

	Number of samples in which contamination was detected *			
	Nutrient Container 1	Nutrient Container 2	Giving Set	Urine Bag
Patient system (n =10)	1	0	6	-
Simulated system (n =10)	0	0	6	8

* Organisms isolated included *Klebsiella* spp., *Enterobacter* spp., *Escherichia coli*, *Pseudomonas* spp., *Acinetobacter anitratus*, *Torulopsis glabrata*.

The Table shows that manipulation of the luer connector is a potential route for cross-contamination to another part of the same patient's system or from one patient to another. The luer connectors were disconnected 5-14 times daily to allow procedures such as aspiration, administration of medication, tube flushing or patient x-ray to take place. In 5/10 patient systems the only feed sample that was contaminated was that collected from the giving set indicating that retrograde growth of the patient's own flora had taken place. In 6/10 of the feed samples from the giving sets and urine bags of the simulated systems the micro-organisms isolated matched those recovered from the parallel patient system. However, no organisms were detected in the nutrient containers of the simulated systems and therefore this route for the cross-contamination of systems would not be detected by routine microbiological monitoring of the discarded nutrient containers.

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Knowledge of nutritional assessment and support within a teaching hospital. By JAYNE REEVES and JEREMY M. D. NIGHTINGALE. *Leicester Royal Infirmary, Leicester LE1 5WW*

A hospital nutrition team/working group aims to optimize the detection, prevention and treatment of malnutrition by educating staff. Before commencing an education program, the nutritional knowledge of eleven dietitians, eleven pharmacists, sixty five final year medical students, thirty doctors and forty eight nurses was assessed. Twenty multiple choice questions were completed anonymously. Based upon locally agreed practice and guidelines, only one of five answers was considered correct. Twelve questions were about nutritional assessment and requirements, five about oral/enteral nutrition and three about parenteral nutrition. The results are shown in the table.

Profession	*n*	Mean score	Range
Dietitians	11	16	12-18
Pharmacists	11	8	5-11
Medical Students	65	8	3-12
Doctors	30	7	2-12
Nurses	48	7	2-9

Overall, 80% of respondents selected the correct units of BMI, but only 65% identified the normal acceptable range. The prevalence of hospital malnutrition was underestimated by 68% of respondents who answered either 8 or 15%. Only 21% (mainly dietitians) knew serum albumin to be a poor measure of nutritional status. Approximately 2000kcal/d was correctly chosen by 92% of respondents as the energy requirement of a well 70kg man. The energy content of 1 litre of 5% dextrose was known by 50% of respondents.

Our local recommended method to confirm the correct position of a fine-bore nasogastric feeding tube is by aspiration of acid. This was correctly indicated by 42% of respondents, although 56% thought that an X-ray was required. Only 13% recognised antibiotic treatment to be the most common cause of diarrhoea in enterally fed patients.

Only 16% knew that liver function test abnormalities, in patients receiving parenteral feeding, commonly relate to a high-carbohydrate feed. The hub connection as the most common source of an infection to the feeding line was correctly indicated by 42%.

Dietitians scored the most correct answers, with 82% achieving full marks for the twelve nutritional assessment and requirements questions. Teaching sessions, to all five groups, are taking place with attention being focused upon areas in which knowledge has been demonstrated to be poor. Although the results of this questionnaire show that general nutritional knowledge about nutritional assessment and support is poor, it provides a framework for teaching and auditing the educational role of our nutrition team/working group.

Gastrostomy feeding : a consumer survey by the LITRE working party

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A questionnaire, based on previous work undertaken by Robson (1994), was distributed to one hundred and twenty five randomly selected dietitians, reporters to the Home Enteral Feeding Register. Each forwarded a questionnaire to one patient currently on home gastrostomy feeding. Twenty eight patients registered with PINNT also took part. Ninty one (59%) of these patients responded. Ages ranged from less than 2 years (1%) and over 85 years (3.4%) with 46% falling into the 46 - 75 years range. Primary clinical conditions were: cancer (22%), stroke (19%), multiple sclerosis (16%), motor neurone disease (14%), cystic fibrosis (14%), head injury (10%), other (5%). Inadequate food intake was related to : an inability to swallow (69%), food refusal (12%) and other causes (19%). Gastrostomy feeding was instigated : to prevent weight loss (45%), to increase weight (36%), for pre-operative feeding (3%), other (16%). In 40% cases gastrostomy feeding was the sole method of feeding. Only 24% had gastrostomy feeding for more than one year and 51% would have liked to have met someone who already had a gastrostomy before theirs was inserted.

Of the sixty four patients who knew what type of catheter they had: forty four (69%) had a PEG (percutaneous endoscopic gastrostomy), eleven (17%) a Button and nine (14%) a foley catheter. Thirty one patients (34%) had had their catheter replaced, fourteen of these more five times. Whilst 88% agreed that the tube was quiet comfortable, 20% said that the exit site bled a lot, 38% that it was currently sore and painful and 41% had been treated with antibiotics for a gastrostomy site infection. A total of 18% had problems with catheter leakage.

A 4.2kJ/ml feed was prescribef for 31%, 24% 6.3kJ/ml, 15% fibre-enriched, 12% paediatric feeds, 12% semi-elemental or elemental and 7% a combination of feeds. Drip-feeding was administered during the daytime (35%), overnight (27%), day and night (17%) and bolus feed by day and drip feed by night (21%). Feeding pumps were used by 86%. Problems were : 33% felt the feed caused diarrhoea, 26% loose stools and 43% that they passed more urine at night. A small number experienced difficulties in obtaining feeds (5%) and equipment (9%).

In total 86% said that they had learned to adapt their lifestyle and forgo holidays (33%). Feeling left out at family meal times was expressed by 51%. Whilst there were problems with gastrostomy feeding, 93% preferred it to a tube in the nose and 98% said that they would recommend it.

Robson, T.J.(1994) *Home Gastrostomy feeding - a patient's/carers perspective. Annual Meeting of British Association of Parenteral and Enteral Nutrition (BAPEN) Abstracts of Interdisciplinary papers.*