PAPERS AND ORIGINALS

Early postoperative feeding with elemental diet

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Summary and conclusions

The value of early postoperative feeding with an elemental diet was assessed in 30 patients after major gastrointestinal operations. The patients were allocated at random to conventional treatment (control group) or feeding with the elemental diet (ED group). The clinical and metabolic course of the 15 patients in the ED group was significantly better than that of the controls. Patients in the ED group lost less weight and had a shorter stay in hospital. Negative nitrogen balance was more pronounced in the control group throughout the seven postoperative days. Energy intake was higher in the ED group.

Provided elemental feeding is used with caution, it may be given from the first postoperative day. Patients do better metabolically and require shorter stays in hospital.

Introduction

Nutritional deficiencies are fairly common in hospital,[1 2] particularly in surgical patients, about half of whom may show protein-energy malnutrition.[3 4] Moreover, their state may be made worse after operation[5] by reduced intake of protein and energy and increased urinary loss of nitrogen. The loss of nitrogen can undoubtedly be reduced by intravenous feeding,[6-8] but this is expensive and there may be several serious complications.[6 9] It therefore seems logical to use the alimentary tract as the natural route for postoperative nutrition.

Several different types of enteral feed have been tried but with only modest success.[10-12] Elemental diets, however, are claimed to be metabolically superior to conventional feeds because little or no digestion is required and they are almost totally absorbed in the upper gastrointestinal tract.[13] An elemental diet is a well-balanced, residue-free mixture of all essential and non-essential amino-acids combined with simple sugars, electrolytes, trace elements, and vitamins.[14] When given before operation elemental diets have corrected malnutrition.[15 16] In an *uncontrolled* study, Delaney *et al*[17] claimed clinical benefit by feeding an elemental diet to patients after operation. We decided to conduct a *controlled* clinical and metabolic study to examine the value of an elemental diet in the early postoperative period after major gastrointestinal surgery. We report here our preliminary findings.

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Patients and methods

From statistical tables, 30 patients undergoing major intestinal surgery were allocated at random to one of two groups. One was fed an elemental diet (ED group), and the other, treated nutritionally in a conventional manner, served as controls. The table gives the age and sex of the patients and types of operation performed.

In patients given the elemental diet a double-lumen tube was passed during the operation through the nose into the stomach. The feeding portion of the tube was threaded into the upper small intestine and the aspirating portion retained in the stomach. The final position of the tube was checked by fluoroscopy. Flexical (Mead Johnson Laboratories) was then infused through the feeding channel, beginning on the first postoperative day. For the first 24 hours a half-strength solution was infused at 25 ml/hour. Thereafter, undiluted Flexical was infused at 25 ml/hour on the second postoperative day, 50 ml/hour on the third postoperative day, and 100 ml/hour on the fourth and fifth days. If there were no complications the double-lumen tube was removed on the sixth day and the patient given as much Flexical as he could take by mouth on the sixth and seventh days. In addition all patients in the ED group were given 2 l dextrose (5% w/v) and 1 l saline (0·9% w/v) intravenously from the first to third postoperative days.

In the control group a conventional nasogastric tube was used for aspiration only. Patients were given 1 l saline (0·9%) and 2 l dextrose (5%) intravenously and allowed nothing by mouth for two days. On the third postoperative day they were given a 30 ml drink of water if there were no contraindications. Thereafter, oral intake was gradually increased until by the fifth day the patients could take as much fluid as desired. Intravenous fluids were stopped on the fifth postoperative day, and a light diet introduced on the sixth and seventh days.

Other aspects of postoperative management were identical in both

Details of patients and types of operations performed

	Mean age (years) ± SE of mean	Sex		Oesophago-gastrectomy	Gastrectomy	Colectomy	Anterior resection	Abdominoperineal resection
		M	F					
ED group (n = 15)	54·8 ± 2·9	8	7	1	3	4	4	3
Control group (n = 15)	54·5 ± 2·8	9	6	1	3	4	2	5

groups. All patients were weighed the day before operation and on the seventh postoperative day. The wound was inspected on the tenth day, or earlier if infection was suspected. The decision to discharge the patient from hospital was taken by the consultant in charge. Fluid and electrolyte balance, energy intake, and nitrogen intake and losses were calculated daily. Nitrogen loss was determined by a micro-Kjeldahl method on pooled 24-hour urine samples.[18]

Data analysis—Non-parametric data were analysed with a Wilcoxon rank sum test. Regression analysis of nitrogen balance was carried out by normal theory method.

Results

Body weight—Patients in the control group lost significantly more weight ($P < 0.01$) than those given the elemental diet, whose median loss was zero (range 1 kg loss to 5·3 kg gain). Patients in the control group had a median weight loss of 1·85 kg (range 5·8 kg loss to 0·5 kg gain).

Hospital stay—Patients in the control group spent longer in hospital (median stay 19 days, range 10-46 days) than those in the ED group (median stay 14 days, range 10-26 days) ($P < 0.05$).

Wound infection occurred in five patients in the control group compared with three in the ED group. Of these eight patients, five had intra-abdominal complications—namely, subphrenic abscesses (one case in each group), pelvic abscess (one case in each group), and an anastomotic leak (one patient in the control group).

Energy intake (fig 1)—Patients in the control group had a lower energy intake than those fed the elemental diet. For the first four days the energy intake of the controls was less than 500 kcal/day. Even by the seventh postoperative day these patients were taking less than 1000 kcal. In contrast, patients in the ED group were taking up to 1000 kcal daily by the second postoperative day, and up to 1600 kcal daily during the second half of the first postoperative week.

Nitrogen losses and intake—Nitrogen balance studies showed that in both groups the urinary output of nitrogen exceeded intake (fig 2). In the control group the mean nitrogen loss on the first postoperative day was 9·8 g/24 h (700·0 mmol/24 h); this increased to 11·9 and 10·9 g/24 h (850·0 and 778·0 mmol/24 h) on the second and third post-

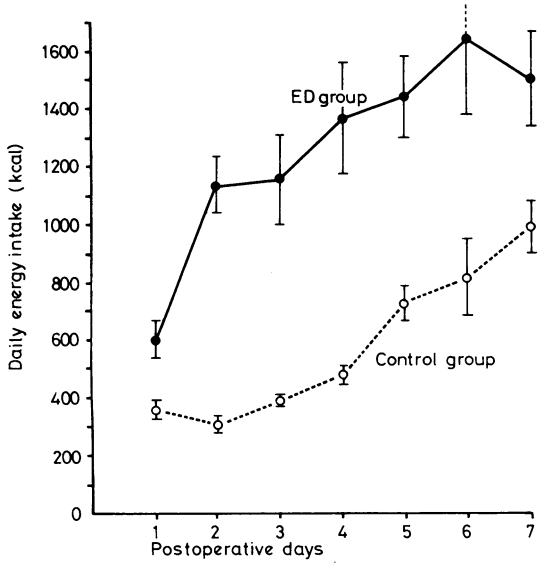

FIG 1—Mean (±SE of mean) energy intakes/day in ED and control groups. (1000 kcal ≈ 4·2 MJ.)

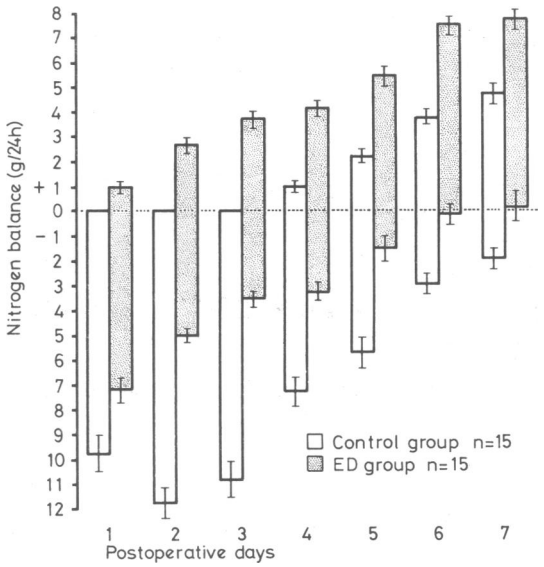

FIG 2—Mean (±SE of mean) nitrogen balance in ED and control groups (after Moore[5]). Nitrogen intake plotted upwards from zero line and output downwards from intake; resultant plots below zero line indicate negative and those above zero line indicate positive nitrogen balance. (Nitrogen: 1 g/24 h ≈ 71·4 mmol/24 h).

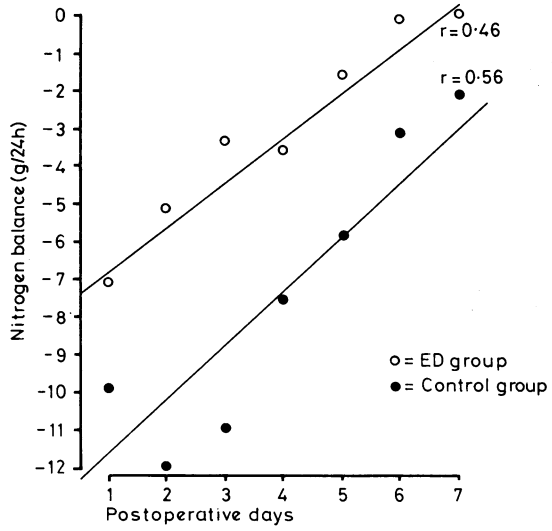

FIG 3—Regression lines of mean daily nitrogen balance in ED and control groups. (Nitrogen: 1 g/24 h ≈ 71·4 mmol/24 h.)

operative days respectively. Since there was no intake of nitrogen during these days, these amounts represent the extent of the negative nitrogen balance. Thereafter the urinary loss of nitrogen decreased, and as oral intake was progressively established the nitrogen balance became gradually less negative. Throughout the seven postoperative days nitrogen balance was less negative in patients given the elemental diet (fig 3). These patients had a positive nitrogen balance by the seventh postoperative day.

Discussion

Most patients who undergo intermediate surgery can survive several days without feeding without serious consequences.[7] After major operations, however, nutrition may be a problem, but oral feeding in the early postoperative period is not popular because of delay in gastric emptying,[19] with the risk of nausea, vomiting, and acute dilatation of the stomach. We[20] and others[21] have shown, however, that in the immediate postoperative period the absorptive capability of the small intestine is unimpaired. Thus feeding by jejunostomy has been attempted but is not generally accepted. In an attempt to decrease the morbidity associated with feeding jejunostomies, Delaney *et al* advocated the use of a fine needle.[22] Despite this improved technique there was a 5% incidence of leakage from the jejunostomy site.[17] We therefore used a special double-lumen nasogastric tube with its feeding portion threaded into the small intestine at operation.

An elemental diet seems to be ideal for postoperative feeding. It is predigested and is almost totally absorbed. It is hyperosmotic, however, and therefore initially needs to be diluted and infused slowly. In the initial phase of our trial two patients developed nausea and diarrhoea lasting for 24 hours. We therefore began with half-strength solution at roughly 0·5 ml/min and thus avoided these complications in our later patients. Another problem with elemental diets is in their palatability. Flexical flavoured with vanilla was the most acceptable to our patients, and the flavour may be altered to overcome taste-fatigue. The original product is now being supplied unflavoured.

Energy requirements of patients after operation depend on the severity of injury and the presence or absence of infection. Patients in our series treated nutritionally in the conventional manner had a pronounced energy deficit, and even by the seventh postoperative day their energy intake was far below their basal needs. In contrast we could provide basal energy requirements to patients in the ED group from the fourth postoperative day onwards. This regimen may have been responsible for the more rapid convalescence and absence of weight loss in this group.

On the metabolic side this aggressive nutritional approach seems to be beneficial. Nitrogen balance in the two groups differed. Patients given the elemental diet had a steady increase in nitrogen intake from the first postoperative day, and by the seventh day were in positive nitrogen balance. On the other hand, the patients treated conventionally did not receive any nitrogen for the first three days, and their intake for the subsequent four days did not make up for their losses. In the first three postoperative days the nitrogen losses in this group were greater than in the ED group, but from the fourth day onwards there was no significant difference between the groups. At the end of the week patients in the control group were still in pronounced negative nitrogen balance. Regression analysis of daily nitrogen balance in the two groups (fig 3) showed that the slopes of the lines were similar but that their positions differed, indicating an identical metabolic response but a greater nitrogen deficit in the control group. Whether this difference was due to any protein-sparing effect of early feeding is difficult to prove at this stage.

Our results suggest that is is feasible to feed patients with elemental diet solutions from the first postoperative day. When this is done cautiously early feeding does not increase morbidity. Metabolically the patients do better in terms of increased protein and energy intake and improved nitrogen balance. In our patients these metabolic gains were reflected in clinical benefit in terms of earlier postoperative recovery and lack of weight loss.

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ONE HUNDRED YEARS AGO Dr Fleck of Marienbad has published, in the *Wien Medicinische Blätter*, the following curious case of chronic constipation, which he ascribes to some anomaly in the innervation of the intestines. The patient, a Dutchman by birth, was of delicate constitution, but well nourished, and had always been more or less subject to constipation; but for the last two years his bowels had become torpid to a most alarming extent, moving only from five to six times a year. It is true that, in the intervals between these evacuations, the patient passed a very small quantity of hard fæces once in six, eight, or ten days, but these motions would hardly amount to the remains of one meal. Two or three days before one of the principal evacuations occurred, the patient began to feel ill, his sleep was disturbed, he was restless, felt disinclined to work, had a very uncomfortable feeling in his back, etc. Then, after a sharp attack of colic, he passed an enormous quantity of horribly offensive fæces; then he felt better for two or three hours, when some more fæces were passed, and so on till he had had four or five motions during the day. On the following day, he only has a slight attack of diarrhœa, after which his bowels relapsed into their usual torpid state; but he felt so wretched and exhausted for several days afterwards, that he dreaded the evacuation more than the coprostasis. At the examination, it was found that the fæces were principally accumulated in the ascending and transverse colon; these intestines could not only be felt, but also seen through the abdominal walls; the abdomen was soft, not much distended; the diaphragm was pushed upwards; all the other organs were perfectly normal. The patient had tried every possible remedy to cure himself of this affliction, including electrotherapy, hydrotherapy, and very voluminous enemata, but had never succeeded in obtaining relief. He had at last come to Marienbad, where he drank the water and took baths; the result of which treatment was, that the bowels moved once in two or three days. The author tries to explain this curious fact by some anomaly in the innervation of the intestines, owing to which they remained torpid till stimulated by some unknown cause, or perhaps through a reflex act, when the accumulated fæces were suddenly expelled.

(*British Medical Journal*, 1879.)