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The Effect of Enteral Fibre-Containing Feeds on Stool Parameters in the Post-Surgical Period

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ABSTRACT

Background/Aim of Study: Specialised nutritional support includes both enteral and parenteral routes. When oral intake is not an option, but gastro-intestinal function is present, enteral tube feeding should be considered. However, one of the complications of enteral feeding access is diarrhoea. The aim of this study was to test the effect of fibre on a local population, in a prospective, single-blinded trial to determine whether the presence of fibre in enteral feeds reduced the incidence of diarrhoea in Asian patients.

Methods: Sixteen post-surgical candidates were randomly assigned to receive a fibre-supplemented (FSF) enteral formula or a fibre-free formula (FFF) for 10 days post-surgery to assess the usefulness of FSF in reducing the incidence of diarrhoea in tube-fed patients. Differences in stool consistency, stool frequency, capillary blood glucose and serum albumin levels between the two groups were determined. Antibiotic usage in both groups was noted.

Results: Patients in the FSF group had more bowel movements throughout the 10-day period and firmer stools than the FFF group, but this difference was not statistically significant (p = 0.39). There were no significant differences in daily mean glucose levels between both groups.

Conclusion: We conclude that there is insufficient evidence that fibre-containing enteral formulae reduce the incidence of diarrhoea in tube-fed patients in the short term. However, these products could inherently be included for patients on tube-feeds during extended periods, with the prospect of maintaining gut function integrity and flora.

Keywords: enteral formula, fibre, diarrhoea

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INTRODUCTION

In malnourished patients with a functioning gastrointestinal tract, enteral tube feeding is the most simple and effective method of providing nutrition[1]. A wide variety of nutritionally complete, ready-to-use products have been developed which have been shown to be suitable for long term use[2].

Diarrhoea is a common complication in tube-fed patients[3] and has been related to enteric infection, loss of circular muscle motility, bile salts and fatty acids and maldigestion or malabsorption[4]. Hypoalbuminaemia, antibiotics and hyperosmolality do not appear to have important effects on absorption of nutrients[5]. The consequences of diarrhoea include dehydration, electrolyte loss, perianal excoriation, problems with nursing care as well as patient discomfort and psychological distress. The control of diarrhoea is therefore important from a medical and social viewpoint.

If the rate or strength of tube-feeding is reduced in order to treat diarrhoea, inadequate nutritional support may be the result[3]. The use of lactose-free formulas, isotonic preparations, and continuous rather than bolus tube feeding have not always eliminated the problem[6], indicating that additional factor(s) are responsible.

Dietary fibre (referring to the residue of plant food resistant to hydrolysis by human alimentary enzymes) has been shown to reduce colonic disorders, reduce the incidence of gall stones, lower mortality from ischaemic heart disease, control diabetes mellitus and obesity[7]. Dietary fibre may have a role in improving glycaemic control in individuals with diabetes. It is said to delay glucose absorption and reduce insulin requirements in both Type I and II diabetes. Evidence in this field is not conclusive[8]. In healthy non-diabetic adult population, fibre has also been shown to modulate blood glucose levels[9].

Studies attempting to ameliorate diarrhoea by addition of various forms of fibre into tubefeeding formulae have not however been conclusive[10-11]. To test the effect of fibre on a local population, a prospective, single-blinded, randomised clinical trial was conducted to determine whether the presence of fibre in enteral feeds reduced the incidence of diarrhoea in Asian patients. In addition to this, it was assessed to compare any differences (if any) in blood glucose levels in the FSF and the FFF group.

MATERIALS AND METHODS

All patients had to meet the following criteria before being enrolled in the study: (1) The American Society for Parenteral and Enteral Nutrition Guidelines for nutrition support[12]; (2) requiring at least ten days of tube feeding; (3) absence of any oral intake during the period of tube

feeding, and (4) requiring and able to maintain a polymeric complete diet. Patients with renal or hepatic failure, haemodynamic instability, malabsorption syndromes, severe septicaemia or infection of the gut were excluded from the study. Nutritional assessment was based on weight and age values whilst energy requirements were calculated using Scholfield's equation[13].

A total of 27 patients were recruited for this study. Eleven patients were excluded from the study due to death (n=7), commencement of oral diet (n=1) or use of an enteral formula (n=3) other than those used in the study. All were neurology or general surgery cases, 11 patients were male and 5 patients were female. The youngest patient was 20 years old and the oldest patient was 81 years of age. Sixteen subjects were assigned to receive fibre-supplemented feeds (FSF) (n=8) or fibre-free feeds (FFF) (n=8), ie. Ultracal▼ and Isocal▼ liquid (Mead Johnson, Bristol-Myers Squibb Singapore Pte Ltd) respectively. Ultracal▼ contains 17% protein, 37% fat, 46% carbohydrate and 1.44g of dietary fibre/100 mL, Isocal▼ liquid contains 13% protein, 37% fat and 50% carbohydrate as the total percentage of energy.

Full strength feeds were delivered by using an enteral pump infusion set (Kangaroo 224, Sherwood Medical-General Medical Supplies). A feed flow rate of 30 mL/hour was administered for 16 hours on the first day of tube feeding. This was gradually increased by 10 mL/hour every four hours on subsequent days until the rate, which fulfilled individual daily nutritional requirements, was achieved. Patients had 8 hours of gut rest and 16 hours of continuous infusion daily. Feed reservoirs were changed every 24 hours and flushed every eight hours. No feeds were hung for more than eight hours in order to reduce microbial proliferation. In our clinical experience, diarrhoea usually occurs within the first few days of tube feeding, ie. during the build-up period. The study was terminated after ten days.

All stools were collected daily and stool consistency and frequencies were measured by staff nurses. Diarrhoea was defined as occurring when both (a) reduced stool consistency ($\geq$ 3 on a working scale of 1 – 5: 1 for hard, 2 for semi-hard, 3 for pasty, 4 for semi-watery, 5 for watery) and (b) increased stool frequency ($\geq$ 3 times per day) were present.

Eight-hourly capillary blood glucose levels were monitored using the Accutrend▼ glucometer (Boehringer Mannheim). Antibiotic usage for each subject was noted.

Non-parametric statistical analyses were used to test for significant differences between the stool frequency and mean glucose levels of the two groups for each day of the study. The Wilcoxon Signed Rank Test was used to test for differences in stool consistency between the two groups. In order to judge the association between the feed type and antibiotic usage when considering other existing parameters such as mean stool frequency, consistency and blood glucose, Chi-square tests of goodness of fit and association were applied. The Statistical Package for Social Sciences (SPSS) for Windows 6.0 (Chicago, II) was used for data analysis. A p value < 0.05 was considered statistically significant.

RESULTS

This study indicated that the number of bowel movements was greater in the FSF group as a whole (Table I). Stool frequency between the two groups, were not significantly different (p = 0.39). Out of the total of 16 subjects, 3 patients ie: subjects 6, 7 and 8 from the FFF group had produced zero stool output. Seventy-seven percent of the stools in the FSF group were hard to pasty as compared to 69% in the FFF group. Similarly, no statistical significance was seen when comparing stool consistency between the Isocal and Ultracal groups when the Wilcoxon Signed Ranked Test was used. The p-value was 0.64.

The mean 8-hourly daily glucose levels of each study day were not significantly different between the groups on FFF or FSF (Fig 1) (p = 0.22). There was no association between FFF/FSF and antibiotic-use in relation to mean stool frequency, consistency and plasma glucose levels on the basis that p = 0.10.

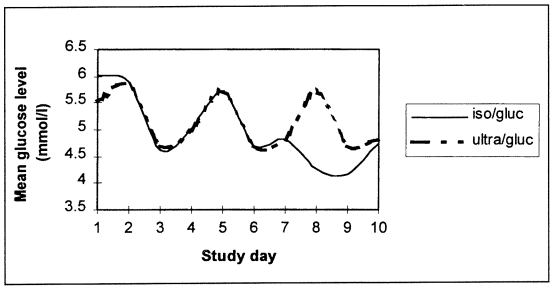

Fig 1 – Mean glucose vs study day

DISCUSSION

Dietary fibre is defined as the sum of three non-starch polysaccharide types: the non-cellulosic polysaccharides, cellulose and lignin. Soluble fibre is said to be important in the control of plasma glucose and cholesterol levels[14], while insoluble fibre is responsible for increasing faecal weight and is therefore employed in the therapeutic management of constipation and diverticular disease.

A variety of fibre-containing enteral nutrition formulae consisting of variable amounts of fibre exists. The source of fibre used could range from wheat, rye, oats, apple, coconut, powdered cellulose, xanthan gum, soy polysaccharide to isphagula husks. The FSF in this study was composed of 44% soy and 56% oat fibre. Soy is mainly an insoluble fibre while oat fibre is mainly soluble.

Though not significant, it was observed that there was a general trend for the mean blood glucose level in the FFF to be lower than the FSF. Other investigators such as Gustafsson and workers who investigated the effect of added dietary fibre on glucose homeostasis in a non-diabetic group also documented that there were no significant differences in glucose

response after adding 4.5g fibre into the test meal[15]. On the other hand, there have been studies which reflect that the high water-holding capacity of some dietary fibre reduces blood glycaemic response and this in turn, was significantly correlated to the total motility index of the small intestine and its stationary activity[9]. These suggest that the contractile activity induced by dietary fibre in the small intestine probably play a role in the delayed glucose absorption. Whether blood glucose levels are directly related to bowel movement and eventually stool output has yet to be elucidated at this point of time.

When dietary fibre is fully hydrated, the soluble and the insoluble components will absorb water and increase viscosity of the contents as early as in the stomach. In the large intestine, the unfermented dietary fibre will contribute directly to faecal bulk while those that are fermented leads to an increase in the bacterial mass excreted. As much as 75% of solid stool mass is bacteria.

Three subjects in the FFF group suffered from constipation during the period of study. Absence of fibre in the feed would imply a lack of substrate for anaerobic colonic flora to ferment and produce short chain fatty acids, carbon dioxide, hydrogen and methane effectively, compromising large bowel function. The FSF group had more regular bowel movements with lesser incidence of constipation and diarrhoea compared with the FFF group, though the results were not statistically significant. This may partially be explained by the fact that any colonic fibre present would have had the potential to absorb luminal-free water softening stools in those constipated but solidifying them in subjects suffering from diarrhoea.

Table I indicates a list of antibiotics of which 12 out of 16 subjects were on at least one course during the study period. It is a well-known fact that one of the adverse reactions of antibiotics is gastrointestinal upsets or diarrhoea attributable to

Table I – Bowel movement and stool consistency in the presence/absence of antibiotics in FSF and FFF group

Subjects	FSF Bowel frequency over 10 days	Consistency of each stool output	Antibiotic	FFF Bowel frequency over 10-days	Consistency of each stool output	Antibiotic
1	3	4 2 2	Erythromycin, Gentamycin	1	1	Fortum
2	6	5 3 2 2 1 2	Rocephine, Flagyl	3	5 5 2	Cloxacillin, Flagyl, Fortum, Gentamycin
3	2	4 1	Nil	1	3	Bactrim
4	2	3 2	Nil	2	2	Flagyl, Rocephine, Cloxacillin
5	6	5 3 3 3 3 3	Ampicillin, Gentamycin Flagyl	9	5 5 5 3 3 3 3 3	Augmentin, Penicillin, Rocephin, Gentamycin, Flagyl, Metronidazol
6	18	3 3 3 3 5 3 3 3 3 2 4 3 3 5 5 5 3 3	Streptomycin, Gentamycin, Rifampicin, Flagyl, Ciprofloxin, Fortum	0	0	Bactrim, Cephazoline
7	0	0	Unasyn, Cloxacillin	0	0	Nil
8	8	5 3 3 3 3 3 2 2	Nil	0	0	Bactrim, Cephalazoline

loss of colonic flora. This study had similar results to those of Hart and Dobb[10] in that there was a weak correlation between antibiotic use and diarrhoea. Keohane et al[6] on the other hand showed that diarrhoea was significantly related to treatment of antibiotics.

Results of our study were similar to work done by Frankenfield and Beyer[11] as we have also deduced that fibre in tube feeds did not seem to have an effect on bowel function. Methodology of this study was also similar except that in Frankenfield's and Beyer's study, stool weight and 24-hour faecal nitrogen were determined. In our study, three participants were constipated and no stool output was detected throughout the study period. In contrast to this, Hart and Dobb[10] treated patients who were constipated for more than three days after starting enteral feeds with suppositories. Past trials included biochemical investigations which delved into colonic fluid measurements ie. concentration of Na^+, K^+ and short chain fatty acids suggest that pectin may be a beneficial supplement to isotonic tube feeding formulae to promote normalisation of colonic function and improve tolerance to tube-feeds. Our study also employed the use of water soluble fibre or pectin in the FSF group.

This study is unique because it is based on an Asian population. As the study relied on nurses reporting the type of stool output, different subjective observations were possible in particular stool consistency. Some of these reasons may affect the data collected.

Based on results from this study, we conclude that there is no real indication for surgical patients requiring short-term nasogastric feed to have routine administration of FSF whilst on antibiotic treatment. However, for those who are on long-term enteral tube feeding, are experiencing persistent diarrhoea and/or suffering from constipation, could consider the potential advantage of using a FSF. This may be beneficial even if the objective is purely for the promotion of healthy gut flora, mucosa integrity and function maintenance.

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