Fibre in Adult Enteral Tube Feeding

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The UK's Scientific Advisory Committee on Nutrition (SACN) recommends that adults consume 18 g of non-starch polysaccharides (NSP) daily.[1] A recent review found a 15-30% reduction in risk of mortality from and incidence of non-communicable diseases when consuming 25-29 g/day of dietary fibre.[2] Fibre also helps maintain gut health, effecting gut microbiota and bowel function.[3] But what is the evidence for using fibre when enterally feeding?

The purpose of this article is to briefly consider the rationale for and evidence supporting the use of fibre when enterally tube feeding in adults, encouraging the reader to consider and further explore the evidence for practice whilst reflecting on their own decision-making processes around choice of enteral feed.

The NICE guidelines for Nutrition Support in Adults states that healthcare professionals should *"ensure that the total nutrient intake of prescribed nutrition support accounts for energy, protein, fluid, electrolyte, mineral, micronutrients and fibre needs."*[4] It is accepted that enteral tube feeds will essentially be 'nutritionally complete' allowing prescription of these such that energy, protein, micronutrient and electrolyte needs are met. But fibre in the context of enteral feeding is often considered an optional extra. Why is this? Reflecting on the history of enteral feeding may help to explain.

A brief history

The concept of enteral feeding is not new with feeding tubes used from the 16th Century to administer mixtures of milk, eggs, broth, sugar, raw beef, wine and whiskey into the stomach.[5] Commercially produced enteral feed does not begin until the late 20th Century and follows advancements in manufacturing and greater understanding of digestion, absorption and nutrition.[5] The development of the Codelid Elemental Diet for the US space programme in the 1960s really changed our understanding of how nutrition could be provided through a 'chemical' diet.[5] This elemental diet could be readily administered via a nasogastric tube with clinical and commercial implications.[6] The 'Wisconsin enteral formula' was reported as being better tolerated than the Codelid formula and advocated for clinical use.[5] It comprised of amino acids, glucose, fat, minerals and vitamins.[5] It wasn't until the 1970s that things began to change in the UK with a move away from blenderised enteral diets to commercially produced enteral feeds. Such manufacturing provided a sterile product with consistent nutritional content, viscosity and osmolarity. This was revolutionary for clinical practice and the dietetic profession, allowing dietitians to move from hospital kitchens to spend more time in clinics and on the wards.

Gastrointestinal problems and changes in bowel function were reported with the Codelid elemental diet. This was not surprising with it being specifically designed to create minimal residue, reduce stool mass and bowel frequency – a necessity for astronauts in space. The addition of 2-4 g of carboxymethyl cellulose per elemental 'meal' did improve bowel function.[5] Carboxymethyl cellulose is a fibre source sometimes used as a laxative so the effect is not unexpected. With this insight it is strange then that fibre was not considered essential when developing enteral feed formula for clinical use. The reason for this is perhaps two-fold.

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Firstly, the level of understanding we have today about the components of dietary fibre and effects on health, the gut and its microbiota has greatly increased over the past 50 years. We now understand that its role is wide-reaching and not just about preventing constipation. Secondly, when used in enteral feeding, fibre can have a physical effect on feed viscosity, with risk of sedimentation and tube blockage.[7] Advancements in manufacturing processes have enabled successful development of fibre-containing products and we now have a range to use in clinical practice today.[8]

Fibre, feed and the gut

Before going any further, let us recap on what dietary fibre does in the gut. Insoluble fibre acts as a bulking agent increasing water absorption into the stool, thus increasing stool weight, whilst gut transit time is reduced.[6] Both actions can help prevent or alleviate constipation. Soluble fibre is fermented anaerobically in the colon producing gases and short chain fatty acids (SCFAs), such as acetate, propionate and butyrate.[9] These encourage colonic reabsorption of sodium and water, possibly reducing diarrhoea.[10] Bacterial-mass is also increased which in turn increases stool weight, which, as mentioned earlier, can help prevent or alleviate constipation.[9] Some soluble fibres may also reduce gastric emptying and slow transit time from mouth to caecum.[9]

The challenge with enteral feed is that it can alter gut physiology, impacting transit time, secretory mechanisms and microbiota.[11] Adverse changes in the colonic microbiota can occur effecting the gut barrier and increasing risk of bacterial translocation.[9] When fibre-free enteral feed was compared with usual diet in healthy volunteers gut transit time slowed and stool weight reduced.[10] Adding fibre should theoretically help to normalise bowel function,[7] however, fibre in enteral feeds does not always have the same effect as fibre in the diet.

Fibre particle size and composition affect how fibre functions in the gut, including degree of solubility and fermentability.[9] In fibre-containing enteral feeds the fibre particle size is often altered to ensure the correct feed viscosity is maintained. For example, an insoluble fibre such as soy polysachharide will be ground to form smaller particles before being added to an enteral feed, thus increasing the degree of solubility and fermentability, altering its effect in the gut.[9] The effect of a fibre-containing enteral feed is therefore not always as would be expected when the same fibre source is consumed orally as part of the diet.

Fibre-containing enteral feeds

The first fibre source used in enteral feed was soy polysaccharide with this also being the most studied fibre containing enteral feed.[7] Effects of soy polysaccharide have not been well studied in the diet[7] although it may increase faecal wet weight.[9] Soy polysaccharide is easily available and technically relatively easy to add to enteral feeds[10] but effects of such an enteral feed on bowel function are conflicting. A systematic review suggests the number of days with diarrhoea might be reduced but this was not statistically significant.[7] This lack of effect may be due to the small fibre particle size and use of a single fibre source in the feed.

Fibre-mixes were subsequently developed using mixtures of soluble and insoluble fibres, including fructooligiosacharides (FOS), inulin, wheat dextrin and cellulose. Mixed-fibre enteral feeds are usually well-tolerated[7] and do not appear to increase gas production when compared to a single fibre source feed.[9] Unlike a fibre-free enteral feed, a mixed-fibre feed in healthy volunteers did not cause constipation or diarrhoea, with suggestion that it 'normalised' bowel function.[10] The beneficial mean fibre intake for those receiving enteral feeds as a sole source of nutrition is suggested as 30 g/day. A caveat to this is that fibre-containing enteral feeds may be contraindicated in certain patient groups. In the UK, fibre-containing enteral feeds generally contain around 1.5 g of mixed fibre sources per 100 ml of a 1 kcal per ml feed, providing 30 g of fibre per 2000 kcal.

Therefore, in practice, when using a fibre-containing enteral feed, the type and amount of fibre contained in the feed, along with volume and patient tolerance, all need to be taken into account.

Diarrhoea

The incidence of diarrhoea in enterally fed patients ranges from 2-95%, with variation due to the differences in diarrhoea definition and the difficulty in measuring stool output.[12] Fibre in enteral feeding may reduce the incidence of diarrhoea, with soluble fibre perhaps being of particular benefit, promoting SCFA production, colonic sodium and water absorption.[7, 12] However, this is not the case for all patients.

A retrospective review identified a greater risk of diarrhoea regardless of the method of feeding, or feed formula, in those with a hospital stay >21 days who were enterally fed for >11 days.[13] A hypothesis of the role of FOS in enteral feeding-related diarrhoea was proposed. Whilst doses of up to 10 g/day of FOS are well tolerated as a placebo in healthy volunteers,[14] treatment for irritable bowel syndrome (IBS) restricts overall FODMAP (fermentable oligo-, di-, mono-saccharides and polyols) load to <0.5 g per meal.[13] This equates to <4 g of FODMAP load per daily volume of enteral feed.[13] To date, only an association between diarrhoea and the FOS content of an enteral feed has been found, suggesting a five-fold reduction in diarrhoea for those receiving <10.6 g/day FODMAP load (the lowest FODMAP feed available).[13] Whilst this is of interest, a randomised controlled trial is required to identify any causal relationship between FOS and enteral feeding-related diarrhoea, and to establish if and how this relates to an IBS diagnosis.

Constipation

The literature focuses on diarrhoea rather than constipation in enteral feeding yet constipation is reported in 15.7-29.7% of enterally fed patients.[15] It is particularly problematic when an enteral feed is the sole source of nutrition,[15] and in the disabled and non-ambulatory populations.[8] Constipation is cited as a more frequent problem than diarrhoea in those requiring exclusive home enteral nutrition (HEN),[7] with such patients often treated with laxatives.[10]

There is suggestion that soluble and insoluble fibre in enteral feeding may be beneficial for those receiving HEN, helping to reduce the need for laxatives.[15] The recent European Society for Parenteral and Enteral Nutrition (ESPEN) HEN guidelines recommend that fibre-containing feeds should normally be used by HEN patients with diarrhoea (Grade A recommendation with strong consensus of 92% agreement) and with constipation (Grade B recommendation B Strong consensus 96% agreement).[16] However, details on the type of fibre and amount are not well described, nor are contraindications discussed. There is a need for more studies of fibre-containing enteral feeds in the community setting.[7]

Critical care

The evidence for using fibre supplemented enteral feeds in critical illness is not clear. Diarrhoea (incidence 29-72%) and high gastric residual volumes are two of the most common complications of enteral feeding in critical illness.[12] This may be due to disrupted colonic microbiota, with lower faecal SCFA and altered bacterial composition identified in those with diarrhoea.[12] One systematic review of fibre in enteral feeding was unable to identify positive effects in critically ill patients.[7] In contrast, a review of critically ill patients found possible benefit in using soluble fibre to manage diarrhoea and reduce incidence.[12] Risk of constipation may also be reduced and a possible benefit on 6-month mortality is described.[12]

The Academy of Nutrition and Dietetics states that there is 'fair' evidence to support using fibre feeds in critical illness, advocating use of a soluble fibre, such as guar gum, to prevent or manage diarrhoea.[17] Recent ESPEN guidelines for clinical nutrition in critical illness make little mention of fibre,[18] whilst the American Society for Parenteral and Enteral Nutrition (ASPEN) supports the use of soluble fibre only in the haemodynamically stable patient.[19] ASPEN advise against using insoluble fibre in this patient group and no fibre in those who are haemodynamically unstable, at high risk of bowel ischaemia or severe dysmotility, or are positive for *clostridium difficile*.[19] What is not considered is the change in the properties of insoluble fibre in enteral feeds due to manufacturing processes, such that they become more soluble. There is clearly a need for further work in this area, but using the current evidence it would seem advisable to proceed with caution when using fibre-containing enteral feeds in those who are critically ill.

Conclusion

The current evidence makes it difficult to confidently make recommendations about fibre-containing enteral feeds. The theoretical benefit of fibre is not always realised in part due to the manufacturing process of fibre-containing enteral feeds often changing fibre properties, including the degree of colonic fermentation and solubility of insoluble fibre sources. Fibre may be helpful in managing diarrhoea or constipation, possibly 'normalising' bowel function unless contraindicated. It may be particularly beneficial for those receiving HEN. The literature also advises caution in using fibre-containing enteral feeds in those who are critically ill, however some guidelines recommend that soluble fibre is beneficial in certain patient groups. There is clearly a need for further research, but perhaps we can all contribute to this by reporting on audits of clinical outcomes to help build a picture of the effectiveness of fibre in the enterally fed patient.

> "...a review of critically ill patients found possible benefit in using soluble fibre to manage diarrhoea and reduce incidence. Risk of constipation may also be reduced and a possible benefit on 6-month mortality is described.[11]"

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