Development of an Algorithm for the Nutritional Management of *Clostridium difficile* Associated Diarrhoea


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The Department of Health guidelines for managing *Clostridium difficile* associated diarrhoea (CDAD) recommend that a 'multidisciplinary clinical review team' approach is undertaken. This includes nutritional review of all patients with CDAD by a dietitian because of the risk of electrolyte imbalance, dehydration, malnutrition and pressure sores[1, 2] However, the guidelines do not specify which nutritional assessments or interventions should be carried out.

Clostridium difficile (C.difficile) infection and associated diarrhoea (CDAD) is an important nosocomial pathogen which is responsible for an increasing incidence of disease in many of our hospitals. It is a highly prevalent infection amongst our hospital patients. The average increased length of stay of a patient in hospital is 21 days, costing an additional £4,000 per case.[1] The risk factors have been formally identified as broad-spectrum antibiotics, age >60 years, intensive care settings and malnutrition.[3] *C.difficile* infection will probably continue to be a problem within the NHS given the increasing elderly inpatient population and the widespread use of broad-spectrum antimicrobial therapy. This article explores how we devised a nutritional management plan for the treatment of *C.difficile* and CDAD.

Development of the algorithm

As part of the recommended multidisciplinary approach to managing CDAD[2] a steering group was formed. Members of the steering group included clinicians from an array of specialist backgrounds including: infectious diseases, gastroenterology, microbiology, infection control and the dietetic department. From these meetings various measures were undertaken in our hospitals to ensure optimum treatment. These include the introduction of an isolation unit, revision of current antibiotic policies and improved antibiotic stewardship, vigilance of the infection control team and improved ward hygiene and awareness. In parallel, it was agreed that an improved nutritional management plan be included in our guidelines.

We reviewed the literature available on nutritional screening, nutritional support and relevant international guidelines produced by different organisations, with or without an evidence base. We collected these and the different management and monitoring charts in use in our hospital with the intention of producing a unified, single sheet algorithm to optimise nutritional assessment and management at ward level. Our review included the evidence for use of probiotics, prebiotics and other nutritional supplementation for managing CDAD.

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The nutritional screening tool

Identifying the risk of malnutrition is an important step for all our hospital admissions. Of the large number of nutritional screening tools that have been developed, we use the 'Malnutrition Universal Screening Tool' ('MUST'), which is part of routine initial assessment procedure for all hospital admissions, followed by weekly screening throughout the admission period.[4]

Nutritional support

Probiotics

A recent Cochrane review concluded that probiotic administration is associated with reduced risk;[5] however the review appreciated that there were limitations in the studies due to poor documentation of the strains used and a lack of assessment of probiotic specific adverse events. Although most trials did not report adverse events few addressed these outcomes. In addition, concerns have been raised over their use in certain patient groups, such as those with neutropenia, HIV and the critically ill, due to the potential risks of causing bacteraemia or fungaemia, and patients with central venous access are considered at high risk.[6] Generally, the patients most commonly affected by these complications are the immunocompromised and these remain the patients who are most likely to progress to severe CDAD or are at risk of CDAD recurrences.[7] Thus probiotics were not included in our algorithm*.

Prebiotics

The small but increasing evidence base for the use of prebiotics suggests that they may have beneficial properties, helping restore microbial communities and support barrier function of the epithelia.[8] They are defined as *'a selectively fermented ingredient that allows specific changes, both in the composition and/or activity in the gastrointestinal microbiota that confers benefits upon the host well-being and health.'* [9]

Substances are considered prebiotics when they meet the following criteria:[10]

1. Be neither hydrolysed nor absorbed in the upper part of the gastrointestinal tract
2. Be selectively fermented by one or a limited number of potentially beneficial bacteria in the intestine
3. Be able to alter the colonic microflora toward a healthier composition.

Prebiotics appear to induce a specific fermentation by beneficial bacteria such as *Bifidobacteria* and *Lactobacilli* at the expense of the other groups of bacteria, helping to improve intestinal flora and reduce the presence of potentially pathogenic bacteria.[10] Furthermore, the fermentation of prebiotics produces short chain fatty acids (SCFAs), which are beneficial to host health.[11] SCFAs can alter the colonic physiology by decreasing the colonic pH, which may create an unfavourable environment for *C.difficile* and indeed has been shown to diminish the growth of *C.difficile* in animal studies.[12] In addition, SCFAs are described as promoting growth of the colonic mucosa and thus improving gut integrity.[11] The increase in SCFAs has been shown to increase colonic sodium, potassium, chloride and water absorption, which is a positive characteristic when treating CDAD.[13] One randomised-controlled trial successfully prevented further episodes of diarrhoea in patients with CDAD, with a significant increase in bifidobacterial numbers compared with the placebo arm.[14]

Prebiotics have been associated with symptoms of dose-dependent abdominal pain, flatulence, and bloating which are thought to be related to the fermentation process. However, they generally have an excellent safety profile[15, 16] and are relatively inexpensive. The decision was made to include within the algorithm.

Nutritional supplements

Intervention for CDAD

The food supplement of choice included in the algorithm is Resource Optifibre (Nestlé Health Science), which is a partially hydrolysed guar gum (PHGG). PHGG has been seen to successfully decrease diarrhoea-predominant forms of irritable bowel syndrome (IBS)[17] and demonstrates a reduction of enema and laxative usage in peritoneal dialysis patients as well as being the preferred choice of patients.[18] Although PHGG is not accepted as a prebiotic, there is some support for its bifidogenic effect and increased SCFA production. Healthy volunteers with low initial bifidobacterial populations in faecal samples displayed a large increase in these after consumption of biscuits containing PHGG.[19] In a double-blind, randomised controlled trial evaluating the use of PHGG to supplement the World Health Organisation Oral Rehydration Solution in children with acute and chronic diarrhoea, the group treated with PHGG supplemented solution had a substantial reduction in the duration of diarrhoea compared to the control group, supporting its use in anti-diarrhoeal therapy.[20] Furthermore, a review of PHGG found it to be a clinically effective supplement.[21] PHGG is fully fermentable in the large bowel, completely soluble and both

* The current evidence that is available to the Author suggests that the usage of probiotics can be useful if applied in community settings with medical supervision.

acid and heat stable. It is inexpensive, easy to store and lacks any significant toxic side effects. It can also be added to food, fluids and easily administered through enteral tubes. These qualities make it ideal for use in a clinical setting.

Intervention for CDAD with malnutrition

Patients who are screened with a 'MUST' score of 2-5 or a MUAC (mid upper arm circumference) of less than 20 cm are identified as being at nutritional risk and, therefore, require further nutritional support, daily food record charts and a more detailed and specific assessment to be undertaken by a dietitian. This includes a high protein, high calorie sip feed with added fructo-oligosaccharide (Ensure Plus Fibre [Abbott Nutrition]), an accepted prebiotic, in addition to Resource Optifibre.[9] Patients who are screened with a 'MUST' score of 6 trigger aggressive nutritional support and those who are nil by mouth are supported with a nasogastric tube (NGT) and fed enterally. The feed formula used contains FOS and fibre, which has also been shown to assist with the reduction in diarrhoea.[22] Bridles are an accessory used to anchor NGTs *in situ* if they are displaced more than three times. When patients are unable to have an NGT, the algorithm instructs further multidisciplinary team (MDT) discussion to determine the most appropriate course of action.

The algorithm

Once a patient has been confirmed to have CDAD, with a positive *C.difficile* toxin tested on a faecal sample, an MDT approach to management immediately commences. Alongside isolation, antibiotic treatment and clinical assessment the nutritional status is evaluated. Once the 'MUST' screening score has been recorded, the Royal Liverpool University CDAD algorithm is then followed (**Figure 1**).

Conclusion

By introducing this novel algorithm into CDAD management, the multidisciplinary team is able to identify patients for nutritional support, instigate appropriate nutritional support, monitor nutritional status and assist in the promotion and improvement of gut health whilst enhancing the treatment of CDAD infection. Our nutritional management algorithm has simplified and appears to have improved management of CDAD within our hospital. Since 2008, our rates of *C.difficile* infection have reduced by over 70%, so we are confident our approach has been successful. However, we appreciate more adequately powered randomised, placebo-controlled clinical trials are required to evaluate the use of prebiotics in CDAD.

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Figure 1: The Algorithm