Nutritional Therapy in Pediatric Crohn Disease: The Specific Carbohydrate Diet

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ABSTRACT

Objectives: Crohn disease is characterized by chronic intestinal inflammation in the absence of a recognized etiology. Nutritional therapy in the form of exclusive enteral nutrition (EEN) has an established role within pediatric Crohn disease. Following exclusive enteral nutrition's success, many dietary therapies focusing on the elimination of specific complex carbohydrates have been anecdotally reported to be successful.

Methods: Many of these therapies have not been evaluated scientifically; therefore, we reviewed the medical records of our patients with Crohn disease on the specific carbohydrate diet (SCD).

Results: Seven children with Crohn disease receiving the SCD and no immunosuppressive medications were retrospectively evaluated. Duration of the dietary therapy ranged from 5 to 30 months, with an average of 14.6 ± 10.8 months. Although the exact time of symptom resolution could not be determined through chart review, all symptoms were notably resolved at a routine clinic visit 3 months after initiating the diet. Each patient's laboratory indices, including serum albumin, C-reactive protein, hematocrit, and stool calprotectin, either normalized or significantly, improved during follow-up clinic visits.

Conclusions: This chart review suggests that the SCD and other low complex carbohydrate diets may be possible therapeutic options for pediatric Crohn disease. Further prospective studies are required to fully assess the safety and efficacy of the SCD, or any other low complex SCDs in pediatric patients with Crohn disease.

Key Words: Crohn disease, dietary therapy, low complex carbohydrate, nutritional therapy, pediatrics, specific carbohydrate diet

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Crohn disease is characterized by chronic intestinal inflammation in the absence of a recognized etiology. Although no cause has been found, evidence from human and animal studies supports the theory that patients with Crohn disease have a dysfunction of their reactive and innate immune system in response to a yet-to-be-determined trigger (1). Although the primary therapies for Crohn disease are medications that possess anti-inflammatory or immunosuppressive effects, nutritional therapy also has an established role within pediatric Crohn disease (2).

Nutritional therapy in pediatric Crohn disease is an effective tool to induce remission (3,4). To date, nutritional therapy aimed at modifying disease activity has primarily referred to either formula-based enteral nutrition or total parenteral nutrition with bowel rest. These therapies have been shown to alleviate clinical symptoms, improve an individual's nutritional status, and improve abnormal laboratory parameters associated with active inflammation. Nutritional therapy, specifically exclusive enteral nutrition (EEN), has been shown to be successful in bringing pediatric patients with Crohn disease into remission as effectively as steroids, with fewer adverse effects and better intestinal mucosal healing (5,6).

Many diets have been reported to be efficacious without scientific evaluation. The specific carbohydrate diet (SCD), which was used initially to treat celiac disease in the mid 20th century, and was popularized in the 1990s, limits grains including wheat, barley, corn, and rice, and uses nut flours such as almond flour and coconut flour to make breads and other baked goods. In addition, sugar is limited to fructose in the form of honey. The diet also restricts most milk products except for fully fermented yogurt. The diet purports decreased intestinal inflammation by restoring the balance of bacteria within the bowels. Although the number of individuals on these diets is not known, we do know that between 36% and 50% of pediatric patients treated for inflammatory bowel disease (IBD) in gastroenterology clinics have used complementary and alternative therapies (7). Because of the prevalence of alternative therapy practices in the pediatric population, and knowing that nutritional therapy in the form of EEN has been shown to be effective at reducing symptoms and inducing remission, we completed a retrospective chart review of our pediatric patients with Crohn disease on low specific complex carbohydrate diets, that is, the SCD.

METHODS

We initiated a retrospective chart review of children with Crohn disease seen at Seattle Children's Hospital from January 2005 to December 2012 who had been receiving SCD dietary therapy. The protocol was approved by the Seattle Children's Hospital institutional review board (IRB study #14368). The diagnosis of Crohn disease was based on conventional criteria, including clinical, radiologic, endoscopic, and histologic findings.

RESULTS

Ten pediatric patients with IBD were identified for this review. Each had been receiving the SCD diet as a treatment for their Crohn disease. Three, who had been receiving concurrent immunosuppressive medications, including azathioprine and remicade, were excluded from analysis. The remaining 7 patients with Crohn disease, 5 boys and 2 girls, were evaluated.

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The average age of patients was 11.3 ± 3.0 years, with a range of 7 to 16 years. Six of the 7 had upper tract disease located within the stomach and duodenum. One child had only ileal disease, 3 had ileocolonic disease, and 2 had colonic disease. One patient had a limited colonoscopy and disease extent could not be defined. No patient had penetrating or stricturing disease. All 7 individuals had at least 1 granuloma not associated with a crypt abscess on biopsy. In defining histologic severity based on the maximal amount of inflammation noted on biopsy, 2 individuals had mild disease, 3 had moderate disease, and 2 had severe disease.

Duration of the SCD therapy ranged from 5 to 30 months, with an average of 14.6 ± 10.8 months. Subjects 1, 2, and 4 started the SCD soon after the diagnosis of Crohn disease. They received no other therapies for their Crohn disease. Patients 3 and 5 received EEN therapy for 2 months before transitioning to SCD. Patients 9 and 10 began the SCD after not improving on mesalamine preparation. Patient 9 did receive prednisone with mesalamine and flared as steroids were weaned off. None of the patients received maintenance immunosuppressive therapies. Patient 9 continued to receive mesalamine therapy, 2 other patients took over-the-counter supplements, and 4 were receiving no other therapy for Crohn disease.

Symptoms

Patients initially presented with Crohn disease with a variety of symptoms: 4 had abdominal pain, 4 had weight loss, 4 had blood per rectum, 2 had chronic diarrhea, and 3 had complaints of fatigue. Table 1 shows an abbreviated PCDAI for patients while receiving dietary therapy (8,9). Although the exact time of symptom resolution could not be determined through chart review, all symptoms were notably resolved at a routine clinic visit 3 months after initiating the diet. Resolution of symptoms remained through all follow-up visits for these children. In addition, all patients had increase in weight and height throughout the dietary therapy. Weight and height velocities were within normal range for all children, except for patient 5, whose weight velocity was 1.8 kg/year and patient 10, whose height velocity was 2.7 cm/year (Tables 2 and 3).

Laboratory Measures

Laboratory indices also showed significant improvement in patients receiving dietary therapy (Table 4). Albumin returned to normal in 5 children whose previous levels had been below normal. C-reactive protein normalized in all 5 children with elevated levels at baseline. Anemia resolved in 4 children with previous low hematocrits. Of the 4 patients with abnormal sedimentation rates before initiation of the diet, 2 individuals had normalization of sedimentation rates, 1 showed improvement, and 1 patient did not have a follow-up study. Not all laboratory values were available for each patient's clinic visit because of physician practice variability.

Normal stool calprotectin is ≤50 μg/g. Four of the 7 patients had stool calprotectin checked (Table 5). One patient's levels dropped from >2500 to 627 μg/g at 3 months, then to 445 μg/g at 6 months. A second patient had levels drop from >2500 to 80 μg/g after 12 months. A third patient did not have calprotectin checked before the diet, but had a stool calprotectin of 16 μg/g after 18 months of receiving the diet. The fourth patient had a calprotectin level of 195 μg/g 3 months after receiving the diet and 48 μg/g at 6 months. All patients with calprotectin levels checked were receiving the SCD therapy alone. The patient taking mesalamine combined with the SCD therapy did not have calprotectin levels measured.

DISCUSSION

Nutritional therapy is central to the treatment and management of inflammatory bowel disease in children. Children with Crohn disease often present with malnutrition, which is associated with increased morbidity. Nutritional interventions in the form of EEN have been shown to reverse associated morbidity, as well as play a key role in the treatment of the disease itself (3–6). The mechanism of action by which nutritional therapy, and specifically EEN, works is unclear, but its efficacy in improving symptoms and reducing mucosal inflammation has been clearly demonstrated in children with Crohn disease (10). In this retrospective study, we have examined the possibility of low complex carbohydrate therapy, specifically in the form of the SCD, for the treatment of pediatric Crohn disease.

Studies on the SCD and other low complex SCDs for the treatment of Crohn disease are lacking. The SCD itself was used by a pediatrician, Sidney Haas, as a way to treat celiac disease in the early 1900s (11). He expanded the use of this diet to treat other intestinal ailments, including ulcerative colitis. Gottschall (12), whose daughter had ulcerative colitis treated by Dr Haas with the SCD, publicized the diet. Since then, many other low complex carbohydrate diets, including the maker's diet, have been developed as potential therapies for inflammatory bowel disease. The primary evidence of success for these diets comes from anecdotal reports. A single case report of 2 adults with IBD did report clinical and endoscopic remission for both patients after 1 to 2 years of receiving the SCD diet (13). An Internet survey of 51 patients with IBD

TABLE 1. Abbreviated PCDAI on low complex carbohydrate diet

Study ID	Before diet intervention	3 mo after	6 mo after	12 mo after	15 mo after	18 mo after
1	20	0	0			
2	30	0	0			
3	30	0	0	0		0
4	10	0	0	0	0	0
5	15	0	0	0		
9	25	0	0			
10	10	0	0	0		

*The abbreviated PCDAI consists of the 3 historical items and the 3 physical examination items of the original PCDAI. The abbreviated index omits laboratory items and calculated height velocity. Scores on the abbreviated PCDAI range from 0 (no disease activity) to a maximum of 70 (severe disease activity) (8,9). PCDAI = Pediatric Crohn Disease Activity Index.

TABLE 2. Growth parameters on specific carbohydrate diet

Weight for age (%)						
Study ID	Before diet intervention	3 mo after	6 mo after	12 mo after	15 mo after	18 mo after
1	45.9 kg (50–75)	48.4 kg (50–75)	50.8 kg (50–75)			
2	32.3 kg (10–25)	33.4 kg (10–25)	34 kg (10–25)			
3	32.7 kg (5–10)	36.1 kg (25–50)	43 kg (25–50)	49.7 kg (50–75)		55.8 kg (50–75)
4	24.8 kg (5–10)	25.8 kg (5–10)	29 kg (10–25)	29.5 kg (10–25)	31.8 kg (10–25)	33.3 kg (10–25)
5	18.9 kg (<3)	19.4 kg (5–10)	20 kg (3–5 kg)	20.4 kg (3–5)		
9	36.9 kg (10–25)	39.3 kg (25–50)	43.3 kg (25–50)			
10	54.7 kg (10–25)	57.1 kg (10–25)	59.5 kg (10–25)	63.2 kg (25–50)		
Height for age (%)						
Study ID	Before diet intervention	3 mo after	6 mo after	12 mo after	15 mo after	18 mo after
1	161.1 cm (50–75)	163.3 cm (50–75)	165.4 cm (50–75)			
2	142.6 cm (25–50)	143.5 cm (25–50)	144.7 cm (25–50)			
3	147.3 cm (25–50)	149 cm (25–50)	151.5 cm (25–50)	158.2 cm (25–50)		163.2 cm (25–50)
4	129.5 cm (10–25)	132.2 cm (10–25)	133 cm (10–25)			
5	119.3 cm (10–25)	120.6 cm (10–25)	122 cm (10–25)	122.8 cm (10–25)		
9	154.1 cm (50–75)	157.9 cm (50–75)	162 cm (75–90)			
10	177 cm (50–75)	177.8 cm (50–75)	178.6 cm (50–75)	180.9 cm (50–75)		
BMI (%)						
Study ID	Before diet intervention	3 mo after	6 mo after	12 mo after	15 mo after	18 mo after
1	17.7 kg/m^2 (25–50)	18.1 kg/m^2 (25–50)	18.6 kg/m^2 (25–50)			
2	15.9 kg/m^2 (10–25)	16.2 kg/m^2 (25–50)	16.2 kg/m^2 (25–50)			
3	15.0 kg/m^2 (<3)	16.3 kg/m^2 (10–25)	18.7 kg/m^2 (25–50)	19.9 kg/m^2 (50–75)		20.9 kg/m^2 (50–75)
4	14.8 kg/m^2 (10–25)	15.5 kg/m^2 (10–25)		15.9 kg/m^2 (10–25)	16.1 kg/m^2 (10–25)	16.6 kg/m^2 (25–50)
5	13.3 kg/m^2 (<3)	13.3 kg/m^2 (<3)	13.4 kg/m^2 (<3)	13.5 kg/m^2 (3–5)		
9	15.5 kg/m^2 (5–10)	15.8 kg/m^2 (5–10)	16.5 kg/m^2 (10–20)			
10	17.5 kg/m^2 (5–10)	18.1 kg/m^2 (5–10)	18.7 kg/m^2 (10–25)	19.3 kg/m^2 (10–25)		

BMI = body mass index.

TABLE 3. Growth velocities on SCD

Study ID	Weight velocity on SCD, kg/y	Height velocity on SCD, cm/y
1	9.5	8.5
2	4.4	5.4
3	11.1	7.6
4	4.8	7.1
5	1.8	4.6
9	12.2	15
10	5.9	2.7

SCD = specific carbohydrate diet.

receiving the SCD diet (31 Crohn disease and 20 ulcerative colitis) noted remission on the diet in 84% of respondents. Sixty-one percent of patients were off all medications, 14% were taking steroids, and 39% were taking 5-aminosalicylic acid (13).

The primary reason for the clinical and laboratory improvements in patients receiving the SCD as well as those receiving EEN is not known. We do know that diet affects the bacteria microflora within our intestines (14). In both Crohn disease and ulcerative colitis, patients have altered microbiota in addition to decreased bacterial biodiversity. This dysbiosis is believed to instigate an inflammatory response in genetically susceptible individuals (15). These diets may work by altering the dysbiosis to a more favorable bacterial milieu for individuals with IBD.

Although EEN is the only nutritional therapy proven to treat both the clinical and inflammatory components of Crohn disease, this retrospective analysis does suggest that the benefits of nutritional therapy may not be limited to EEN. Our results show within a small sample size of pediatric patients that the SCD has a positive effect on both symptoms and inflammatory markers. Although weight and height velocities were satisfactory for most of the children, the SCD does limit the variety of foods a child can eat. This may affect total energy intake and may result in suboptimal weight gain and growth. Patients receiving the SCD should have close follow-up, including anthropometric measurements and nutritional intake evaluation. There are limitations to our study, including its retrospective and descriptive nature, small sample size, as well as the inability for us to know the true number of patients trialing the SCD and therefore the true efficacy of the diet. This study suggests that the SCD may be a possible therapeutic option for

TABLE 4. Laboratory studies on low complex carbohydrate diet

Albumin levels, g/dL						
Study ID	Before diet intervention	3 mo after	6 mo after	12 mo after	15 mo after	18 mo after
1	3.2	3.9	4.2			
2	3.4	3.9	4.3			
3	3.5		4.2	4.1		4.1
4	3.8	4.5	4.3	4.5	4.3	4.3
5	3	3.2	3.8	3.4		
9	3.8		4.1			
10	3.2	4.6	4.2	4.1		
C-reactive protein, mg/dL						
Study ID	Before diet intervention	3 mo after	6 mo after	12 mo after	15 mo after	18 mo after
1	4.2	0.8	1.2			
2	2.4	0.8	0.8			
3	5.8		0.8	0.8		0.8
4	0.8	0.8	0.8	0.8	0.8	0.8
5	2.8	0.9	0.8	0.8		
9	2.1		0.8			
10	6.1	0.8	0.8	0.8		
Hematocrit (%)						
Study ID	Before diet intervention	3 mo after	6 mo after	12 mo after	15 mo after	18 mo after
1	36.3	39.9	40.1			
2	35.5	37.7	37.7			
3	35.3		38.2	42.5		42.5
4	41	41.7	40.6	39.7	37.7	39.6
5	33.9	34.9	34.6	36.7		
9	36.9		38.2			
10	42.3	45.8	47	44.5		

*For Seattle Children's laboratory normal values for albumin is between 3.8 and 5.4 g/dL; normal range for C-reactive protein <0.8; normal range for hematocrit between 34% and 40%.

TABLE 5. Stool calprotectin levels (μg/g) on low complex carbohydrate diet

Study ID	Before diet intervention	3 mo after	6 mo after	12 mo after	15 mo after	18 mo after
1	>2500	627	445			
2		195	48			
3						<16
5	>2500			80		

*Normal stool calprotectin is ≤50 μg/g.
Data adapted from *Gastroenterol Clin North Am* 2012;41:483–95.

pediatric patients with Crohn disease. Further prospective studies are required to fully assess the safety and efficacy of any specific diet in patients with pediatric Crohn disease.

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