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Pilot study

Lower ileostomy output among patients with postoperative colorectal cancer after being supplemented with partially hydrolyzed guar gum: Outcome of a pilot study

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ABSTRACT

Background: High stoma output is a significant complication after bowel surgery that causes dehydration, resulting in acute kidney injury, electrolyte imbalances, unintentional weight loss, and malnutrition. This study evaluates the postoperative ileostomy output among patients with colorectal cancer after being supplemented with partially hydrolyzed guar gum.

Methods: This cross-sectional study collected sociodemographic and clinical characteristics, stoma output, and dietary intake upon discharge, hospitalization, and readmission within 30 d of discharge.

Results: A total of 29 participants were recruited, with 72.4% having moderate malnutrition risk. Patients who received partially hydrolyzed guar gum (PHGG) fiber reported lower stoma output with firmer output consistency than patients who received standard care (SC) ($P < 0.05$ and $P < 0.01$). Patients who received PHGG achieved higher energy, protein, and soluble fiber intake than did the SC group ($P < 0.01$) upon discharge. There was a significant inverse association between soluble fiber (PHGG fiber + dietary soluble fiber) intake and ileostomy output (r, −0.494; $P = 0.006$).

Conclusions: Partially hydrolyzed guar gum fiber acts as an agent to hold water, reduce the speed of gastrointestinal tract transit, increase effluent viscosity, and potentially decrease water losses. Supplementation with PHGG fiber appeared to minimize ileostomy output and improve clinical outcomes among postoperative ileostomy patients. This needs to be evaluated further with a randomized controlled trial to confirm this preliminary finding.

Introduction

A surgical opening in the abdomen, called a stoma, is used to divert the gastrointestinal tract where feces are excreted. Ileostomy is used to discharge fecal contents into an external pouch from the ileum [1]. Approximately 8–10 L of fluid are handled by the human intestine daily, where the jejunum and ileum absorb most of the fluid. Out of an estimated 1.5 L of fluid that reaches the colon, 100 mL is excreted [2]. A high-output stoma is defined as output greater than 1.5 L/d [3–5]. Without proper management of persistent high stoma output, dehydration, depletion of magnesium and sodium, acute renal injury, and malnutrition are likely to occur [1]. A retrospective study by Bai et al. reported a 23.07% incidence of high stoma output [6], which was higher than earlier reports (17%) [1]. The most frequent symptoms of high stoma output were dehydration (37.7%) and electrolyte disturbance (28.1%). In patients with high stoma output, 26% had an ileostomy, 30% recorded readmission to the hospital within 30 d after discharge, and 37% were readmitted because of dehydration [7].

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Postoperative ileostomy management involves pharmacologic therapy, and nutritional interventions are included in the management to improve the adaptation and performance of the remnant bowel [8]. The dosage of antimotility agents such as loperamide and Lomotil should be tapered accordingly, depending on the patient's stoma output and clinical evaluation [9]. Antimotility agents are commonly used to slow down gastrointestinal motility to maximize nutrient absorption, whereas antisecretory agents suppress gastric secretion and further diminish the loss of nutrients caused by diarrhea [9]. The nutritional intervention aims to improve nutrition intake, decrease stoma output volume, and improve consistency. Individualized nutrition intervention is based on the patient's nutritional requirements, considering hydration, and is followed by the prescription of an oral nutrition supplement (ONS) (enteral nutrition) or parenteral nutrition (PN) [10]. To promote wound healing and control stoma output, a high-protein, high-energy, low-fiber diet is prescribed once the patient is permitted oral consumption after surgery.

Prebiotic fiber, insoluble fiber, and soluble fiber are hydrolyzed or absorbed in the gastrointestinal tract [11]. Some studies suggested that soluble fiber such as guar gum can provide a dichotomous stool-normalizing effect that either softens the hard stool in constipation or firms the watery stool in diarrhea [12,13]. Previous studies showed that partially hydrolyzed guar gum (PHGG) fiber has a prophylaxis role in minimizing radiation-induced diarrhea among patients receiving pelvic radiation [14]. A randomized, double-blinded study resulted in a significant reduction in diarrhea occurrence under total enteral feeding or supplemental feeding after adding 22 g/L of PHGG fiber into enteral feeds [15]. PHGG fiber also reduced acute diarrhea in intensive care settings [16]. However, previous studies on the use of prebiotic fiber failed to show a significant reduction in episodes of diarrhea among patients in intensive care [17]. Owing to the mixed findings, the use of prebiotic fiber (insoluble and soluble fiber) in reducing diarrhea remains inconclusive, leading to soluble PHGG fiber as a possible intervention strategy for minimizing stoma output.

Several local cases reported from Malaysia stated that PHGG fiber assisted in reducing high stoma output for patients with colorectal cancer after ileostomy [18] and for chemotherapy-induced high ileostomy output [19]. Other than the case reports, to the best of our knowledge, no other study has evaluated postoperative ileostomy output after supplementation with PHGG fiber. Thus, the present study evaluates the postoperative ileostomy output among patients with colorectal cancer after receiving supplementation with PHGG fiber.

Materials and Methods

Study design

This cross-sectional study was initiated between the years 2019 and 2020. A data collection form was used to record the renal profile, stoma output (volume and consistency), and dietary intake upon discharge; hospitalization; and readmission within 30 d of discharge. The study was approved by the Medical Research Ethics Committee, Malaysia (registration number, NMRR-19-3119-51323) and was registered at clinicaltrials.gov (identifier, NCT04678349).

Study population

The study was conducted in a surgical ward in the Institut Kanser Negara (National Excellence for Cancer Treatment), a tertiary hospital. All colorectal cancer patients with ileostomy were screened postoperatively for the inclusion criteria of the present study. Those receiving postoperative PN, those on other intervention studies, and those receiving palliative care or with fistula were excluded.

Because there was no similar study on the effect of postoperative PHGG in patients with ileostomy, for the sample-size rule of thumb for pilot studies, Julious [20] suggested a minimum sample size of 12 patients.

Study tools and parameters

All parameters and variable data were recorded in the data collection form. Nutrition assessment was conducted by the dietitian in charge as standard care upon admission. The validated and calibrated measurement tool was a scheduled, calibrated weighing machine that measures body weight up to 0.1 kg. The patients were requested to wear minimal clothing, empty their pockets, and stand upright with bare feet on the scale's metal plate. A scheduled, calibrated, Seca height measurement (up to 0.1 cm) was used to measure height. The patient needed to be barefoot, stand upright, and face forward during measurement. The 3-Minute Nutrition Screening is a validated, simple, and reliable tool to screen for malnutrition among hospitalized patients in Malaysia [21]. A reliable and sensitive screening tool is needed to screen patients at risk of malnutrition [21]. The investigator (dietitian) assessed the energy, protein, and soluble fiber intake via 24-h dietary recall on the discharge day.

Ileostomy stoma output (mL/d) and consistency and the renal profile upon discharge were recorded. The hospitalization was counted from admission to discharge. The surgeon determined the time to discharge for the patients according to the discharge criteria. Discharge was allowed when stoma management was mastered and was based on preestablished criteria such as oral pain management, independent mobilization, sufficient food intake, gastrointestinal function, and the absence of suspected complications [22]. Readmission within 30 d of discharge and the reason for being discharged were recorded.

Participants

Eligible patients were informed of the study upon discharge. They gave informed consent and were briefed on participation in the study. If they were willing to participate, the consent forms were signed and dated. After consent, the data (3-Minute Nutrition Screening, weight, ileostomy output, albumin, renal profile, and dietary intake during hospitalization) were traced and recorded.

All participants were operated on by the same specialized surgeon and managed by the same team (surgeon, dietitian, and medical staff). The dietitian assessed all participants' nutrition status and calculated the energy and protein requirements using 30 kcal/kg/d and 1.2 g/kg/d of protein, as recommended by the European Society for Clinical Nutrition and Metabolism guidelines 2021 for adult patients with cancer [23]. All participants were prescribed an ONS, which is part of the standard nutritional intervention for postoperative ileostomy. The standard postoperative ileostomy nutritional intervention is an ONS and a high-protein, high-energy, low-residue diet. After data collection in the standard care group was completed, the initial standard practice was revised to integrate the PHGG supplementation in the standard nutrition intervention (an ONS and a high-protein, high-energy, low-residue diet). All patients recruited under the initial standard practice were in the standard care (SC) group, whereas all patients recruited after the revised standard practice were included in the PHGG group. All decisions on the prescription of ONS and PHGG were made with the consensus of the same team as mentioned above, because this was part of continuous improvement in nutritional therapy. A similar standard ONS provision that provided an additional 500 kcal and 20 g protein was prescribed for each participant. One type of standard formula (Calco, Valens, Malaysia) and one type of PHGG supplementation (Gucil, Valens, Malaysia) were used in this study. The Calco formula provides 40 kcal, 1.7 g protein, and 0.5 g soluble fiber per scoop; PHGG fiber supplementation provides 7.6 g soluble fiber and 0 g sugar per scoop. The dietitian in charge reviewed and recorded the participants' ONS compliance and dietary intake in the medical record system.

Statistical analysis

The analysis was performed using IBM SPSS Statistics for Windows, version 22.0 (IBM Corp., Armonk, New York). Data are presented as the mean ± standard deviation or as medians with interquartile ranges. Categorical data are presented as frequencies and percentages and the numerical data as means and standard deviations. The independent *t* test was used to analyze and compare numerical data that were normally distributed between two groups, and the Mann-Whitney test was applied for non-normally distributed data. The Pearson χ^2 test was used to study the association between stoma output and variables. All probability values were two-sided, and a P value < 0.05 was considered statistically significant [24]. Energy, protein, and soluble fiber intake from 24-h dietary recall upon discharge were analyzed by the diet analysis and nutrition food label software Nutritionist Pro (Axxya Systems). Food in the 24-h dietary recall was entered into the system and showed energy, protein, and soluble fiber intake in kilocalories and grams.

Result

A total of 39 patients were screened, and 32 patients who met the inclusion criteria were approached upon discharge. Of the patients who met the inclusion criteria, two refused to participate and one had incomplete anthropometric data. Hence, a total of 29 participants (16 men and 13 women) were recruited. Thirteen patients received a high-protein, high-energy, low-residue diet with standard formula (SC group), and 16 participants received a high-protein, high-energy, low-residue diet with standard formula and PHGG supplementation (PHGG group). Table 1 shows the sociodemographic and clinical characteristics of participants at admission. The median age was 64.6 y in the PHGG group and 61.8 y in the SC group. Most of the participants were diagnosed with stage III cancer (55.2%), followed by a locally advanced stage (31%). Based on the 3-Minute Nutrition Screening, 72.4% of patients had moderate malnutrition risk. The median percentage of weight loss within 6 mo was 6.3% in the PHGG group and 7.8% in the SC group.

Table 2 indicates the comparison in clinical and nutritional outcomes upon discharge between the PHGG and SC groups. The PHGG group reported a lower stoma output with firmer output consistency than did the SC group ($P < 0.01$). The PHGG group achieved higher energy, protein, and soluble fiber intake upon discharge than did the SC group ($P < 0.01$). Figure 1 shows the stoma output in the PHGG and SC groups upon discharge. There was a significant inverse association between soluble fiber intake and ileostomy output upon discharge (r, −0.494; $P = 0.006$) (Fig. 2).

Table 2
Comparison of clinical and nutritional outcomes between the PHGG and SC groups upon discharge

Clinical status	PHGG	SC	P value
Hospitalization	12	13.0	0.215 *
Stoma output	371.5 ± 93.6	476.9 ± 111.9	0.004†,‡
Bristol Stool Chart			
Type 5	10	1	<0.001§,‡
Type 6	3	9	
Type 7	0	6	
Biochemical profile			
Albumin	31.2 ± 5.2	27.2 ± 3.0	0.016†,‖
Urea	4.7 ± 1.6	3.7 ± 1.8	0.114
Sodium	136.1 ± 4.5	134.4 ± 4.2	0.31
Potassium	3.8 ± 0.4	3.7 ± 0.6	0.99
Creatinine	64.6 ± 13.6	65.4 ± 22.2	0.91
Nutritional profile			
Weight	56.4 ± 15.1	52.2 ± 6.0	0.314
Energy intake	1193 ± 188	959 ± 159	0.002†,‡
Protein intake	49.1 ± 5.2	41.9 ± 7.0	0.005†,‡
Soluble fiber intake	32.3 ± 6.3	7.7 ± 1.2	< 0.001†,‡

PHGG, partially hydrolyzed guar gum; SC, standard care
* Mann-Whitney *U* test
† Independent *t* test
‡ $P < 0.01$.
§ Fisher exact test
‖ $P < 0.05$.

Discussion

Postoperative ileostomy management aims to improve recovery, minimize complications, and maximize the patient's quality-of-life outcomes by adapting the remaining small bowel [8]. With the adaptation process, the remaining small intestine increases the efficiency of fluid and electrolyte absorption to compensate for the function of the colon. The residual bowel length and sites of resection determine the degree of intestinal adaptation [9].

In the present study, patients who received PHGG showed no significantly shorter length of stay compared with those receiving SC, but they had significantly better ileostomy output, both in volume and consistency. The result was consistent with that of a case series [18]. Physiologically, the colon helps with fluid and electrolyte absorption. Hence, patients with an ileostomy may have challenges, including nutrient malabsorption and high and/or watery output [4,5]. The shorter remaining gastrointestinal length might increase the risk of nutrient malabsorption and malnutrition [25]. The major postoperative complication of ileostomy is high stoma output, in which excessive fluid and electrolyte loss through the stoma leads to hypovolemia and dehydration within days and undernutrition within weeks, even causing multiple hospital readmissions after discharge. Paquette et al. reported that about 17% of 30-d postdischarge readmissions were caused by dehydration or acute renal failure after ileostomy creation [26].

Integration of a multidisciplinary approach in clinical management is essential to enhance postoperative recovery and ensure a better quality of life [5,18]. A high-protein, high-energy, low-fiber diet is prescribed postoperatively to patients with an ileostomy to promote recovery and prevent nutritional depletion and even malnutrition [4,27]. The Ostomy and Nutrition Guide (2021) recommends initiating a low-residue and high-protein diet after the operation, and a normal diet resumes once the remnants of the bowel adapt [28]. Small and frequent meals (six meals a day) and adequate fluid intake (6 to 8 cups of water a day) are recommended in the transitional period. To prevent high stoma output, patients are asked to avoid sugary beverages and are encouraged to consume hypertonic fluids rather than plain water [10].

Nutritional management aims to reduce the stoma output volume and improve consistency. The individualized nutrition intervention is based on the patient's nutritional requirements, considering hydration, enteral nutrition, and possible PN. In the present study, to achieve postoperative energy and protein requirements for patients with colorectal cancer who had an ileostomy, the dietitian integrated intensive nutritional management, which included an ONS, while patients were started on a normal

Table 1
Sociodemographic, nutritional, and clinical characteristics of participants during admission

Characteristic	PHGG	SC	P value
Sociodemographic			
Age, y	64.6	61.8	0.503*
Sex			
Male	7	9	0.596†
Female	6	7	
Ethnicity			
Malay	3	11	0.034‡,§
Chinese	6	3	
Indian	4	2	
Clinical profile			
Cancer stage			
II	4	0	0.035‡,§
III	7	9	
Advanced	2	7	
Biochemical profile			
Albumin	33.5 ± 6.6	34.6 ± 4.4	0.098†
Nutritional status			
Height	1.60 ± 0.05	1.61 ± 0.09	0.628†
Weight	58.1 ± 15.3	56.4 ± 7.08	0.719†
BMI	22.6 ± 5.2	21.9 ± 2.9	0.651†
Weight loss within 1 mo, %	3.4	3.5	0.871*
Weight loss within 6 mo, %	6.3	7.8	0.288*
3-min Nutrition Screening			
Moderate malnutrition risk	10	11	0.422‡
Severe malnutrition risk	3	5	
Energy intake	1264 ± 513	1215 ± 274	0.732†
Protein intake	50.4 ± 16.3	43.1 ± 10.1	0.174†

BMI, body mass index; PHGG, partial hydrolyzed guar gum; SC, standard care
* Mann-Whitney *U* test
† Independent *t* test
‡ $\chi 2$ test
§ $P < 0.05$.

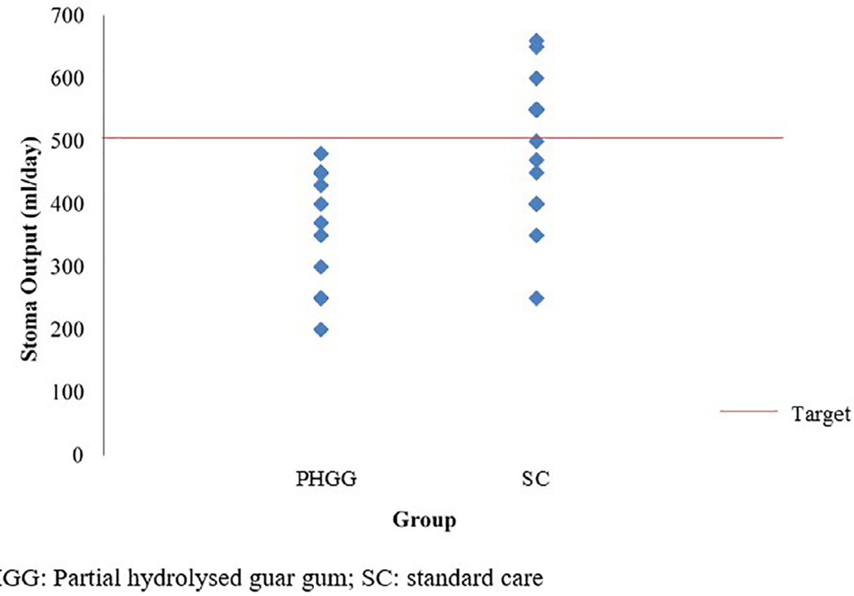

Fig. 1. Comparison of stoma output (mL/d) between the partially hydrolyzed guar gum and standard care groups upon discharge.

high-protein, low-residue diet; none of the participants in the present study started on PN. Patients who have a total colectomy with ileostomy need higher energy and protein because of the absence of the colon for absorption of water and certain nutrients [27,29]. To monitor and improve adherence to the new nutrition intervention guideline, an individualized continuous nutrition intervention consultation after discharge is crucial [10]. In the multidisciplinary team, dietitians assess and identify nutritional deficiencies, address the dehydration issue, revise the nutrition care plan, and follow the individual nutrition interventions.

Among the types of stomas, patients with an ileostomy have higher nutrition-related complication risks. High and watery stoma output and stoma blockage are common postoperative challenges among patients with an ileostomy [30]. Dietitians must be aware of nutritional deficiencies and dehydration and revise the nutrition management accordingly. Besides prescription of a high-protein, high-energy diet and an adjunct antidiarrheal agent, nutritional management for high and watery postoperative ileostomy output comprises dietary fiber restriction [3,25], oral rehydration salt and oral fluid restriction, additional table salt for high stoma output [3], starchy carbohydrate and gelatin in food to firm output [31], and avoidance of caffeinated drinks and hypo/hyperosmolar drinks to reduce osmotic diarrhea [32].

Intensive nutritional management improves nutrition, including preventing weight loss and maintaining adequate energy protein intake and hydration status. Multidisciplinary team approaches are essential to optimizing the result of postoperative outcomes [32]. Dietitians play key roles in the nutrition care

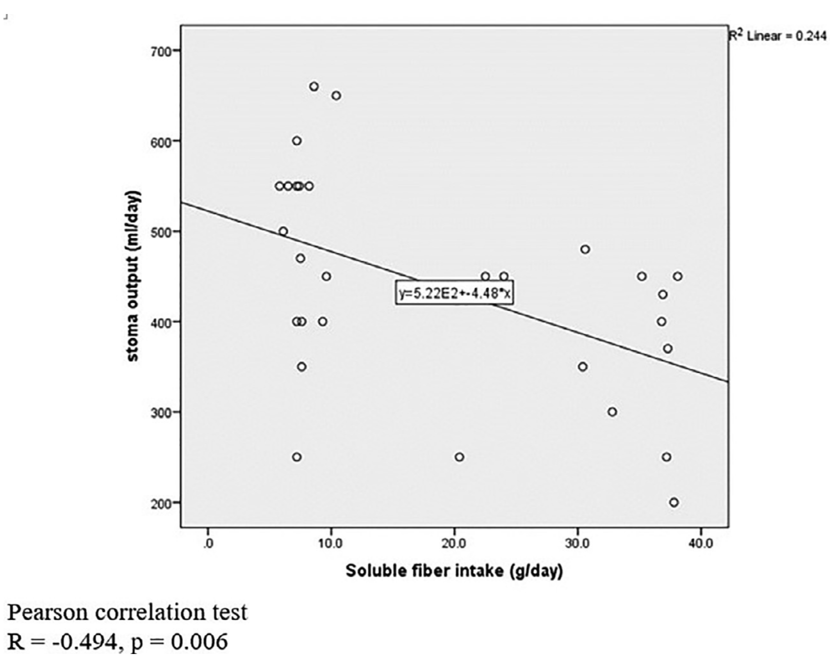

Fig. 2. Correlation between stoma output (mL/d) and soluble fiber intake (g/d) upon discharge. Pearson correlation test: r, −0.494; P = 0.006.

process, such as nutrition assessment and individualized nutrition intervention to determine energy and protein requirements [28]. The nutritional outcome depends on the degree of patient adherence to the nutrition intervention. The present study showed the PHGG group achieved higher energy and protein intake as compared with the SC group, even though both groups were managed by a single dietitian. Patients who have a high-volume, loose, watery stoma output might attempt to restrict their oral intake and not comply with the prescribed ONS regimen to reduce or control the stoma output [10]. With better-controlled stoma output and close monitoring by dietitians, patients with an ileostomy are more confident in oral intake with a high-protein, high-energy diet and higher adherence to the ONS regimen.

The Ostomy Nutrition Guideline recommends restricting insoluble fiber to control stoma output [28,33]. In the present study, the PHGG group achieved a higher soluble fiber intake but a stoma output of lower volume and better consistency than did the SC group. This finding was consistent with a scoping review that demonstrated that soluble fiber has positive outcomes on the stoma output [29]. The PHGG fiber, as a soluble fiber, acts as an agent to hold water and reduce the speed of transit in patients with intact gastrointestinal tracts [34]. Soluble fiber supplements (PHGG) have been trialed to increase the viscosity of effluent and potentially decrease water losses [18,19,33]. A repeated postoperative ileostomy comprehensive nutrition intervention plan during hospitalization and after discharge is crucial to increase adherence to the new nutritional intervention, promote recovery, and improve clinical outcomes [8]. Integration of PHGG fiber supplementation in postoperative nutrition intervention and education for patients with an ileostomy should be incorporated as part of medical nutrition therapy.

Strengths and limitations

This study acts as an evaluation of nutrition management in routine postoperative ileostomy clinical care among patients with colorectal cancer. The findings of the study are hypothesis-generating. The ONS formula option was made based on routine clinical care, but this might introduce a confounding factor. Additional future large-scale studies such as double-blinded randomized controlled trials are warranted to further investigate the effect of PHGG fiber in postoperative ileostomy output management among cancer patients.

Conclusions

Comprehensive postoperative nutrition intervention with the integration of PHGG fiber supplementation promises better postoperative outcomes, including improved ileostomy output, better energy, protein, and soluble fiber intake, and minimized postoperative complications. After discharge, a comprehensive, multidisciplinary, long-term postoperative plan with nutritional education following the medical nutrition therapy for patients with an ileostomy is warranted.

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