Original Article

Association between anxiety, depression, and bowel air bubbles at colonoscopy: a prospective observational study

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Background: Psychological illness could affect the gut transmission. However, few studies have reported on the association between anxiety and depression and bowel preparation failure at colonoscopy. Bowel air bubbles have become an indispensable index to evaluate intestinal cleanliness. The aim of the present study was to investigate whether anxiety and depression are associated with the bowel air bubbles.

Methods: The present study was a prospective observational study of patients who underwent colonoscopy in our hospital. Participants received the standard bowel preparation guidance, including split-dose polyethylene glycol and a low-fiber diet 1 day before colonoscopy. The primary outcome was degree of the bowel air bubble, measured by bubble scores. Univariate and multivariate logistic regression analyses were used to verify the association between anxiety and depression and bowel air bubbles.

Results: A total of 304 patients were enrolled in the present study between July 2019 and January 2020; 302 of these had complete data. The mean age was 48.74±11.73 years. Fifty six of 302 patients had anxiety. Age between 45 and 60 years [odds ratio (OR): 2.09, 95% confidence interval (CI): 1.13–3.87], age >60 years (OR: 1.99, 95% CI: 1.01–3.95), and anxiety (OR: 3.85, 95% CI: 2.12–6.97) were identified as risk factors for bowel air bubbles. A bachelor degree and above (OR: 0.27, 95% CI: 0.07–0.97) were identified as protective factors for bowel air bubbles.

Conclusions: Anxiety is an independent risk factor of bowel air bubbles in colonoscopy diagnosis. Medical professionals should be mindful of this prior to performing colonoscopy.

Keywords: bowel air bubbles, anxiety, depression

Introduction

Colonoscopy is one of the most effective means to evaluate the colorectal situation, and plays an important role in the screening, diagnosis, and treatment of colorectal diseases. Colonoscopy is one of the key measures for the secondary prevention of colorectal cancer (CRC) (1). Bowel preparation has been regarded as an important factor in the success of colonoscopy for CRC screening. The quality of colonoscopy is closely related to the accuracy of colonoscopy diagnosis and the safety of treatment. If the intestinal tract is not fully prepared, the detection rate of lesions will be reduced, the unnecessary examination time will be prolonged, and the incidence of discomfort and adverse events will be increased (2).

In recent years, bowel air bubbles have become an

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indispensable indicator to evaluate intestinal cleanliness. During colonoscopy, there are many folds in the intestinal tract, which have a certain impact on the inspection field (3). Therefore, it is important to maintain high-quality intestinal cleanliness during the examination. Too many air bubbles in the intestinal tract are known as bowel air bubbles, and can cover up the lesion itself, leading to a missed diagnosis (4). At present, simethicone is commonly used as a defoamer at home and abroad, and is sometimes used in combination with intestinal cleansers to improve the defoaming rate and bowel preparation quality.

However, there are still some defects in the use of simethicone (5), such as its bad taste and failure to improve the detection rate of colon polyps. Its safety and effectiveness still need to be evaluated. Psychological factors can also lead to bowel preparation failure. A systematic analysis indicated that anxiety may lead to problems, such as inadequate bowel preparation and difficulty in inserting endoscope (6). Because patients are concerned about the test results and the adverse reactions that may be caused by the examination itself, such as abdominal pain, watching a video description of colonoscopy can relieve their tension and improve the quality of colonoscopy.

People with a high incidence of bowel air bubbles often also have anxiety; however, to the best of our knowledge, there is no current research on the association between anxiety and depression and bowel air bubbles. The present study focuses on the effect of anxiety and depression on the degree of bowel air bubbles in colonoscopy, and in future it could intervene in people with high risk of bowel air bubbles to improve the quality of bowel preparation.

We present the following article in accordance with the STROBE reporting checklist. (available at http://dx.doi.org/10.21037/apm-21-540).

Methods

Study design

The present study was a prospective observational study of patients undergoing colonoscopy at Guangdong Provincial Hospital of Traditional Chinese Medicine from July 2019 to January 2020 (Guangzhou, China). The trial was registered with the Chinese Clinical Trial Centre (registration No. ChiCTR1900024504), and received approval by the ethics committee of Guangdong Provincial Hospital of Traditional Chinese Medicine.

In this trial, all colonoscopies were performed by experienced endoscopists, who had performed >1,000 colonoscopy procedures; trainees were not included in the research. During the procedure, all the treatments were performed normally, and the operator would give the diagnosis based on the examination. All patients were informed about the nature of the study, including the aims and potential advantages and risks, and provided informed consent prior to collection of the questionnaires. All procedures performed in this study involving human participants were in accordance with the Declaration of Helsinki (as revised in 2013).

Inclusion criteria

The inclusion criteria were adult patients aged between 18 and 70 years and scheduled for outpatient colonoscopy.

Exclusion criteria

The exclusion criteria were as follows: (I) intestinal obstruction and stenosis; (II) abdominal surgery (including gynecological surgery, appendiceal surgery, and laparoscopic surgery); (III) pregnancy and lactation; (IV) those who meet the contraindications of colonoscopy (severe suppurative inflammation of anus and rectum; severe acute enteritis and ischemic bowel disease; peritonitis, intestinal perforation, extensive intra-abdominal adhesions, and intestinal stenosis caused by various reasons; patients with a large abdominal aortic aneurysm, abnormal bowel flexion, and advanced cancer accompanied by extensive intra-abdominal metastasis; and weakness, and severe cardio-cerebral disease, severe pulmonary dysfunction, and intolerance to the examination); (V) patients with previous inflammatory bowel disease; (VI) failure to perform standardized bowel preparation; (VII) use of simethicone and other defoamers in bowel preparation; (VIII) incomplete data.

Procedure

All patients used the standard intestinal preparation plan. They were advised to eat a low-fiber diet 1 day before endoscopy, and took 68.56 g polyethylene glycol (PEG; Shenzhen Wanhe Pharmaceutical Co., Ltd., Shenzhen, Guangdong, China) with 1,000 mL warm boiled water at 08:00 p.m. the night before the examination. The patients fasted on the examination day, then took 137.15 g PEG with 2,000 mL warm boiled water 5 h prior to examination; routine colonoscopy was then performed. The clinicians
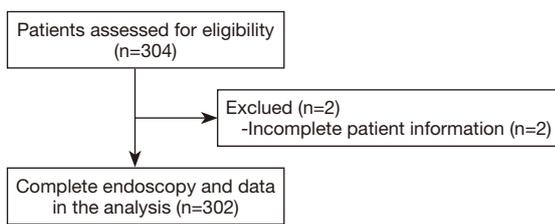
Figure 1 Study flow diagram.

instruct the patients to fill in the questionnaire, answer the questions of the questionnaire, and ensure the accuracy of the questionnaire. The clinician was responsible for collecting and sorting through the completed questionnaire, and two researchers input data to the software and checked the data to ensure that they were correct.

Outcomes

General patient information, bubble score, bowel preparation score, and the anxiety and depression score were collected. All colonoscopies were performed by experienced physicians in the endoscopy center. All physicians were trained to complete the Boston scale before study commencement, and were responsible for recording the bubble score and bowel preparation under endoscopy. The primary outcome was degree of the bowel air bubble, measured by bubble scores and evaluated by the doctor who performed the gastrointestinal endoscopy. The bubble scale was used in a previous study described by McNally *et al.* (7,8). According to the bubble scale (8), the degrees of bowel air bubbles are divided into 4 levels [grade 0, no bubbles; grade 1, minimal or occasional bubbles (must be looked for actively); grade 2, moderate bubbles (obviously visible); grade 3, severe or too many bubbles]. The data were collected by questionnaire survey. In addition, the Boston Bowel Preparation Scale (BBPS) was used to evaluate the feces and liquid in the intestinal cavity by doctors who performed the gastroenteroscopy (9). When the total BBPS score ≥6, it was defined as high-quality bowel preparation. In contrast, inadequate bowel preparation was indicated by a total BBPS score <6.

Sample size calculation

The present study was an observational study, referring to the multi-factor sample content estimation method. The sample size calculation formula was as follows:

N=observation variable × [5–10] times. A total of 304 patients were initially included.

Statistical methods

The χ^2-test or Fisher's exact test was used for the categorical data. Student's *t*-test or 1-way analysis of variance was used for continuous variables and between-group differences, including mean (± standard deviation) and range. If the data did not conform to the normal distribution, the Mann–Whitney *U*-test was used. Regression analysis was used to explore risk factors of bowel air bubbles. The mean significance test α=0.05. P<0.05 was considered statistically significant. Missing data is not used to analyze. SPSS version 22.0 (IBM Corp., Armonk, NY, USA) was used for data analysis.

Results

General patient characteristics

Patients undergoing colonoscopy at the Digestive Endoscopy Center of Guangdong Hospital of Traditional Chinese Medicine from July 2019 to January 2020 were included in the study. A total of 304 questionnaires were issued, and 2 were excluded from the study (*Figure 1*). Patient demographics and baseline characteristics are shown in *Table 1*. There were 137 males (45.4%) and 165 females (54.6%), with a male-to-female ratio of 0.83:1. The ages of all included patients were from 18 to 70 years. The mean age of the included patients was 48.74±11.73 years. In terms of body mass index (BMI), 25 were underweight, 183 were normal, and 94 were overweight or obese. In terms of education, 10 had a primary school education, 151 had a secondary school education, and 141 had a bachelor degree or above. Of the 302 patients, 55 had a history of smoking, 247 had no history of smoking, 49 had a history of alcohol consumption, and 253 had no history of alcohol consumption.

Demographic and clinical characteristics with anxiety or depression

Fifty six of the 302 patients had anxiety in the present study. Of these, 15.3% (21/137) were males and 21.2% (35/165) were females; 10.9% (11/101) of the patients aged 18–45 years had anxiety, 23.9% (34/142) of those aged 45–60 years, and 18.6% (11/59) of those >60 years (P=0.038)

Table 1 Demographic and clinical characteristics of 302 patients with anxiety or depression

Item	Overall (n=302), n (%)	With anxiety (n)	Without anxiety (n)	P value	With depression (n)	Without depression (n)	P value
Sex				0.234			0.012*
Male	137 (45.4)	21	116		32	105	
Female	165 (54.6)	35	130		61	104	
Age (years) [18–70]				0.038*			0.063
18	101 (33.4)	11	90		23	78	
45	142 (47.1)	34	109		47	96	
≥60	59 (19.5)	11	47		23	35	
BMI				0.682			0.567
Low weight	25 (8.3)	4	21		10	15	
Normal	183 (60.6)	37	146		56	127	
Overweight or obese	94 (31.1)	15	79		27	67	
Education				0.187			0.485
Primary school	10 (3.3)	4	6		4	6	
Middle school	151 (50.0)	28	123		50	101	
Bachelor degree or above	141 (46.7)	24	117		39	102	
History of colonoscopy				0.760			0.370
Yes	112 (37.1)	22	90		38	74	
No	190 (62.9)	34	156		55	135	
Reasons for colonoscopy				0.889			0.728
Abdominal discomfort	73 (24.2)	15	58		23	50	
Change of bowel habit	57 (18.9)	10	47		19	38	
Postoperative review of intestinal polyp	39 (12.9)	7	32		12	27	
Physical examination	60 (19.9)	13	47		22	38	
Hemorrhoids	20 (6.6)	2	18		5	15	
Hematochezia	21 (7.0)	2	19		3	18	
Intestinal polyps	20 (6.6)	4	16		5	15	
Other	12 (4.0)	3	9		4	8	
Smoking history				1.000			0.872
Yes	55 (18.2)	10	45		16	39	
No	247 (81.8)	46	201		77	170	
Alcohol consumption				0.112			0.506
Yes	49 (16.2)	5	44		13	36	
No	253 (83.8)	51	202		36	173	

Table 1 (*continued*)

Table 1 (*continued*)

Item	Overall (n=302), n (%)	With anxiety (n)	Without anxiety (n)	P value	With depression (n)	Without depression (n)	P value
Satisfaction with bowel preparation				0.021*			0.644
Satisfied	175	25	150		52	123	
Neutrality	113	30	83		38	75	
Dissatisfied	14	1	13		3	11	
BBPS				0.064			0.533
Inadequate bowel preparation	59 (19.5)	16	43		16	43	
High-quality bowel preparation	243 (80.5)	40	203		77	166	
Bubble score				<0.001**			0.827
0	33 (10.9)	0	33		8	25	
1	108 (35.8)	10	98		33	75	
2	126 (41.7)	37	89		40	86	
3	35 (11.6)	9	26		12	23	

*P<0.05; **P<0.001. BBPS, Boston bowel preparation scale; BMI, body mass index.

(*Table 1*). There was a significant difference in satisfaction with bowel preparation between those with anxiety and those without (P=0.021) (*Table 1*). There was also a significant difference in the degree of bowel air bubbles (P<0.001) (*Table 1*).

Ninety three of the 302 patients had depression in the present study. Of these, 23.3% (32/137) were males and 37% (61/165) were females. There was a significant difference in the sex between those with depression and those without; 22.8% (23/101) of the patients aged 18–45 had anxiety, 33.1% (47/142) of those aged 45–60 years, and 39% (23/59) of those >60 years (P=0.063) (*Table 1*).

Univariate and multivariate analyses for bowel air bubbles

The risk factor analysis was based on 302 patients in the present study. The univariate and multivariate analyses for bowel air bubbles are shown in *Table 2*. Four variables (age 45–60 years, a bachelor degree and above, history of colonoscopy, and anxiety) had a P value <0.05.

For the multivariate analysis, 4 variables (age 45–60 years, age >60 years, university education and above, and anxiety) were found to be independent predictors for bowel air bubbles. Age 45–60 years [odds ratio (OR): 2.09, 95% confidence interval (CI): 1.13–3.87], age >60 years (OR: 1.99, 95% CI: 1.01–3.95), and anxiety (OR: 3.85, 95%

CI: 2.12–6.97) were identified risk factors for the bowel air bubbles. University education and above (OR: 0.27, 95% CI: 0.07–0.97) were identified protective factors for bowel air bubbles.

Discussion

Good intestinal cleanliness can provide a clear visual environment, which is important to improve the quality of colonoscopy. Multiple meta-analyses have indicated that adequate intestinal preparation is associated with significantly lower detection rates of adenomas and advanced adenomas (10,11). A prospective observational study showed that the rate of missed diagnosis of colorectal adenomas ≥5 mm size was 3 times higher when the intestinal preparation was insufficient (12). In China, 32–57% of colons have obvious intestinal vesicles, which may affect endoscopic examination (4). Previous studies have suggested that the presence of surface bowel air bubbles may be related to colonic viscosity, gastrointestinal motility, and bile secretion and excretion (13).

Psychological factors can also cause bowel preparation failure. Hertig *et al.* found that, in irritable bowel syndrome (IBS) patients, intestinal symptoms (constipation or diarrhea), abdominal pain, abdominal distension, and gas in the intestinal cavity were correlated with psychological

Table 2 Univariate analysis and multivariate analyses for bowel air bubbles in the study (n=302)

Item	Univariate analysis		Multivariate analysis	
	P value	OR (95% CI)	P value	OR (95% CI)
Sex				
Female	0.668	0.90 (0.60–1.39)	0.458	0.82 (0.49–1.38)
Male	Control		Control	
Age (years) [18–70]				
18	Control		Control	
45	0.040*	2.01 (1.02–3.47)	0.019*	2.09 (1.13–3.87)
≥60	0.059	1.39 (0.93–3.05)	0.048*	1.99 (1.01–3.95)
BMI				
Low weight	Control		Control	
Normal	0.486	0.85 (0.54–1.34)	0.697	0.91 (0.56–1.48)
Overweight or obese	0.429	0.72 (0.32–1.63)	0.476	0.73 (0.31–1.73)
Education				
Primary school	Control		Control	
Middle school	0.801	1.06 (0.69–1.61)	0.703	0.91 (0.57–1.46)
University and above	0.042*	0.28 (0.08–0.95)	0.045*	0.27 (0.07–0.97)
History of colonoscopy				
No	Control		Control	
Yes	0.025*	0.61 (0.39–0.94)	0.432	0.36 (0.20–0.65)
Reasons for colonoscopy				
Abdominal discomfort	0.419		0.077	2.60 (0.90–7.49)
Change of bowel habit	0.62		0.163	2.14 (0.74–6.23)
Postoperative review of intestinal polyp	0.428		0.564	1.35 (0.48–3.77)
Physical examination	0.284		0.049	2.88 (1.01–8.24)
Hemorrhoids	0.861		0.492	1.54 (0.45–5.30)
Hematochezia	0.923		0.708	1.26 (0.37–4.34)
Intestinal polyps	0.903		0.317	2.07 (0.50–8.62)
Other	Control		Control	
Smoking history				
No	Control		Control	
Yes	0.293	1.34 (0.78–2.30)	0.242	1.63 (0.82–3.26)
Alcohol consumption				
No	Control		Control	
Yes	0.497	0.82 (0.47–1.45)	0.323	0.65 (0.32–1.31)

Table 2 (*continued*)

Table 2 (*continued*)

Item	Univariate analysis		Multivariate analysis	
	P value	OR (95% CI)	P value	OR (95% CI)
Satisfaction with bowel preparation				
Satisfied	0.277	0.57 (0.21–1.57)	0.33	0.59 (0.21–1.70)
Neutrality	0.515	0.71 (0.26–1.98)	0.674	0.79 (0.27–2.33)
Dissatisfied	Control		Control	
Anxiety				
No	Control		Control	
Yes	<0.001**	3.39 (1.93–5.37)	<0.001**	3.85 (2.12–6.97)
Depression				
No	Control		Control	
Yes	0.418	1.21 (0.77–1.89)	0.366	1.24 (0.77–2.00)

*$P<0.05$; **$P<0.001$. BMI, body mass index; CI, confidence interval; OR, odds ratio.

stress (14). In their study, Gorard *et al.* observed the intestinal transport time of 21 patients with mental and emotional disorders using the oral method of radioactive markers (15). The frequency of intestinal movement was found to be faster in anxious patients, and the time of intestinal movement was slowest in depressed patients (15). This suggests that psychological factors, such as anxiety and depression, can affect the degree of bubbles in the intestinal lumen by regulating the speed of intestinal transport. However, there are few reports on the factors influencing bowel air bubbles. In the present study, we preliminarily investigated the relationship between anxiety and depression and bowel air bubble cleanliness.

The number of bowel air bubbles was not statistically significant in terms of sex, age, BMI, education, smoking history, and alcohol consumption. A slightly higher proportion of women were randomly enrolled for colonoscopy in the present study. Previous studies have found that men are more likely to undergo colonoscopy than women, and that men have a higher incidence of CRC and females chose colonoscopy because of the inconvenience caused by the lack of female endoscopists (16). The sex distribution of patients in the present study was different from those of previous epidemiological studies, which may be due to the long distance between relevant epidemiological studies. With the popularization of medical knowledge, more female patients have realized the importance of colonoscopy screening. In terms of age, the colonoscopy group showed a younger trend, among which the young and middle-aged group was the most. This may be related to the recommendation of guidelines for CRC screening as early as possible for people at moderate risk, especially those >50 years (17). Ladabaum *et al.* made a nationwide prediction based on census data and found that colonoscopy after age 45 could avoid the occurrence of CRC to the greatest extent (18). However, due to the large social and economic pressure and irregular diets of young and middle-aged people, experimental studies found that high-fat diets activated tumor-related macrophages and accelerated the deterioration of intestinal adenoma (19). Therefore, young and middle-aged people are more likely to undergo colonoscopy.

In terms of the relationship between anxiety score and bubbles, in the univariate analysis in the present study, we found that the anxiety standard score was correlated with the number of bowel air bubbles, and the higher the anxiety standard score, the higher the bubble score. After multi-factor adjustment, anxiety was found to be a risk factor for bowel air bubbles.

A study of anxiety and colonoscopy (20) found that women were more likely to have anxiety compared with men. Similarly, people who have their first colonoscopy, not complete their course of laxatives, and not be familiar with the procedure are more anxiety. This study also discussed whether anxiety resulted in patients having difficulty completing the bowel preparation process,

leading to a decline in the quality of bowel preparation. A multivariate analysis found that anxiety may be caused by gastrointestinal discomfort (20). Women were also more likely to have anxiety compared with men, which partly due to sex difference in certain neural circuits (21-23).

There are many reasons that affect the generation of bowel air bubbles, and these are mainly related to gastrointestinal motility. Gas is transmitted from the upper digestive tract to the colorectal segment through intestinal peristalsis (24), and bubbles are generated during peristalsis. Previous studies have found that anxiety is related to intestinal movement from the upper site (15). In the present study, we found that the number of bubbles decreased from the right to the left of the intestinal segment, that is, from the cecum to the rectum, indicating that the gas in the colon segment may originate from the small intestine. Studies have shown that a large number of patients have anxiety about colonoscopy and examination results, and such anxiety may induce increased frequency of intestinal movement, resulting in more bubbles, which stick to the colon wall and affect the visual field of examination (15,20).

The close relationship between anxiety and depression, known as psychological distress, and IBS has been demonstrated extensively in the literature (24-27). IBS patients with gastrointestinal issues tend to be at a high level of anxiety, which is known as gastrointestinal-specific anxiety (28). However, a multivariate analysis on IBS and stress indicated that colonic transit time has no significant difference in patients with and without anxiety and depression (27). Another study on lactose malabsorption and intolerance indicated that anxiety, which may be the result of fear of abdominal pain and diarrhea triggered by food, increases the risk of lactose intolerance (29). This intolerance is a result of rapid small intestinal transit and bacterial imbalance (30).

Studies have shown that the video explanation before the examination can reduce the anxiety of patients to a certain extent (20), as can music and brochures. Other studies have shown that there is a certain relationship between gas in the intestinal cavity and mental pressure of patients (14).

Psychological factors are closely related to the digestive system. Many studies have shown that homeostatic regulation of intestinal microecology is associated with psychological diseases, especially depressive behaviors (31-33). However, depression and anxiety are often accompanied by changes in colon dynamics, which in turn change the composition and stability of intestinal microbiota, as well as the physiology and morphology of the colon (34,35). Depression is usually accompanied by changes in colonic transport (27,36). Experimental studies have clearly shown that changes in colonic motility occur in depressed mice, and the driving agent of exercise change is due to the increased expression of kinesthetic neuropeptides, intestinal hormones, and serotonin in the colonic wall (37,38).

In patients with IBS who also have depression, changes in colon motion caused by depression aggravate the severity of intestinal dysfunction and further destroy the stability of intestinal flora (39,40). A statistically significant association between intestinal microbial composition and depression and slow colon metastasis in IBS patients has been found in a previously published study (41). A Japanese study found that depression was associated with the patients with a lower frequency of bowel movements and laxatives had higher depression-related risk factors (42).

In terms of the relationship between BBPS score and bubbles, the BBPS score included whether the fecal liquid affected the visual field. The higher the score, the better the intestinal preparation quality. In the present study, it was found that the group with fewer bubbles had a higher BBPS score, indicating that there were fewer bubbles and fewer liquid pairs of fecal slag remaining in the intestinal cavity. The BBPS score may have taken into account the bubble condition to some extent, which was consistent with the bubble condition evaluation. However, excessive bubbles are difficult to be rinsed out in colonoscopy with sterile water alone, which can have a serios impact on observation of the intestinal cavity. Therefore, the evaluation of intestinal preparation quality should be more comprehensive and include the evaluation of bowel air bubbles. Guo *et al.* used the bubble score as a supplement to the BBPS score to evaluate intestinal cleanliness in order to explore the detection rate of colorectal adenoma (43). They found that 65.7% of patients had bowel air bubbles that affected visual field observation, and the bowel air bubbles were negatively correlated with the detection rate of adenoma.

Limitations

The present study has some limitations. First, this was a single-center study, and all the included cases were from Guangdong Hospital of Traditional Chinese Medicine. The source is single, the research time span was not large enough, and there are regional seasonal factors, so it probably represents the characteristics of colonoscopy

patients in this region. Second, the number of included cases was small, mainly because the questionnaire covered a wide range of items and took some time to complete. People are generally time poor, which increases the difficulty of questionnaire completion. Third, we adopted the questionnaire survey method in the present study. Although we explained the questions and options in detail to the patients, patients may have different understandings of these when filling in the questionnaire, resulting in certain bias. In future studies, we hope to use the questionnaire on a larger sample size, and conduct multi-center studies to further explore the relationship between bowel air bubble cleanliness and anxiety and depression so as to determine a bowel preparation plan for intervention and provide strong scientific support for individualized high-quality intestinal preparation.

The present study included 302 patients who underwent colonoscopy. No significant differences in sex, age, BMI, level of education, smoking history, alcohol consumption, and distribution of depression score between the 4 groups were found; however, the anxiety score and BBPS score demonstrated statistically significant differences. As the degree of the bowel air bubble increased, anxiety scores also increased and the BBPS scores decreased. To improve the quality of bubble clearance, bowel preparation for intestinal preparation, and satisfaction, the first step is to reduce anxiety. This could be done with the use of details brochures or a video on the procedure, and with an emphasis on the psychological guidance before colonoscopy. This could broaden patients' understanding of the procedure and alleviate stress. Face to face counseling should be actively conducted according to different needs, with targeted nursing work.

In the present study, the association of anxiety on bowel air bubbles were discussed, and we found that personalized early intervention could improve the quality of intestinal preparation and clarity of the intestinal field so as to improve the quality of colonoscopy.

Acknowledgments

Footnote

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