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Effect of rhubarb on nutritional status and prognostic recurrence in patients with functional gastrointestinal disorders

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Abstract: Functional gastrointestinal disorders (FGID) are the most common digestive tract diseases in clinical practice, showing an increasing incidence and a shift towards onset at a younger age in recent years. In recent years, the application of traditional Chinese medicine characteristic therapies in various diseases has become increasingly common. For FGID, traditional Chinese medicine characteristic therapies also have great potential. Rhubarb is an excellent herbal medicine and is common in TCM treatment, but it is not clear how effective it is in FGID. In this study, we observed the therapeutic effect of rhubarb acupoint application on FGID, thus providing a new treatment option for FGID. The results showed that patients in the research group treated with rhubarb had a significantly shorter symptom improvement time compared with patients in the control group treated with conventional therapy ($P<0.05$). Also, the gastrointestinal function after treatment was significantly better in the research group than in the control group ($P<0.05$). In addition, the nutritional status of the research group was better after treatment, while the prognostic recurrence rate was reduced ($P<0.05$). These results confirmed that rhubarb is an excellent FGID treatment regimen with high clinical value.

Keywords: Functional gastrointestinal disorders, health management, nutritional status, prognosis, rhubarb

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INTRODUCTION

Functional gastrointestinal disorders (FGID) are the most common gastrointestinal diseases in clinical practice, which are mainly caused by abnormal gut-brain interaction and structural abnormalities caused by physiological, psychological and social factors and are clinically manifested by recurrent gastrointestinal symptoms, such as functional dyspepsia, intestinal stress syndrome and constipation (Duffy *et al.*, 2023). The results of the World Epidemiological Survey of 2022 showed that the prevalence of FGID is as high as 18-45% in the adult population, with a trend towards a younger age of onset in recent years (Toca *et al.*, 2022). FGID are also a common complication of various diseases. In the treatment of fractures, tumors, nervous system diseases, etc., more than 40% of patients experience FGID in different degrees (Daly & Zarate-Lopez, 2021). As we all know, the gastrointestinal tract is the main site for the human body to absorb and metabolize nutrients, which is closely related to human nutritional status (Pathipati *et al.*, 2023). The occurrence of FGID will seriously affect the normal nutritional intake of the human body, promote the massive loss of nutritional proteins and trace elements and destroy the health of the body, thus causing various critical diseases or leading to poor prognosis (Pomenti *et al.*, 2022). Therefore, the treatment of FGID must be taken seriously by both clinical practice and patients.

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In modern Chinese medicine, FGID are defined as Fu-qi obstruction due to qi stagnation, so the disease is often treated with drugs capable of replenishing qi to invigorate the spleen, warming kidneys to support yang, clearing fu-organs and purging turbidity and activating blood to remove stasis (Sankararaman *et al.*, 2022). Among them, rhubarb is the palm-shaped leaf of the Rheum genus (Polygonaceae), which has the effects of purgation, clearing away heat and fire, cooling blood, detoxifying, removing blood stasis and dredging channels (Chen *et al.*, 2022).

In diseases such as chronic kidney disease and colitis, rhubarb is often used as an adjuvant drug to achieve remarkable application results (Wang *et al.*, 2012; Yan *et al.*, 2023), but its influence on FGID is still rarely reported. Not only that, in clinical pharmacology studies, astragalus acid, flavonoids and other compounds in rhubarb have been shown to aid human digestion and promote intestinal decongestion and these components can reduce the production of free radicals, which can help improve intestinal inflammation (Zhuang *et al.*, 2020). These studies establish the potential of rhubarb to improve FGID and positively impact the nutritional status of patients.

Based on this, this study observed the clinical effect of rhubarb acupoint application on FGID and implemented targeted health management measures on this basis, aiming at providing new reference and guidance for the future treatment of FGID and ensuring the health of FGID patients.

MATERIALS AND METHODS

Sample size calculation

The following parameters were set according to the total number of cases admitted to our hospital in one year: confidence =90%, error (E)=10%, probability (P)=0.5, statistic (Z)=1.64, sample size (N)=$Z^2\times[P\times(1-P)]/E^2$=96.

Study population

In this study, 100 FGID patients admitted to our hospital from January, 2022 to June, 2023 were selected and randomized into a control group and a research group (50 patients in each group). We statistically analyzed patients' age, sex, body mass index and other clinical data and found no notable inter-group differences (P>0.05), indicating comparability (table 1). The Ethics Committee of our hospital approved this study (2023NL-091-01) and all the subjects signed the informed consent form.

Eligibility and exclusion criteria

Inclusion criteria: The included patients (1) met FGID clinical diagnostic guidelines (Black *et al.*, 2020), (2) aged over 18and (3) were willing to cooperate in this study, (4) with complete medical records. Exclusion criteria: Patients with (1) cardio-cerebrovascular diseases, (2) hematological system diseases, (3) mental illness, or (4) gastrointestinal malignant tumors, (5) those during pregnancy or lactation, as well as (6) referrals and withdrawals due to other factors, were excluded.

METHODS

Control group: (1) Fasting and parenteral nutrition support were given to patients with unrecovered gastrointestinal function. While those with gastrointestinal function recovery were given enteral nutrition and a balanced diet. For symptoms associated with acid-base imbalance or electrolyte disorders, they would be corrected in a timely manner. (2) Closely monitor the changes of patients' vital signs, regularly inspect the ward daily (3 times/d), once the patient's vital signs appear abnormal changes need to promptly notify the doctor. (3) Remind the patient to get out of bed regularly and instruct the patient to perform some simple rehabilitation exercises. Teach patients and their families to perform abdominal massage to promote bowel movement. (4) Nurses took the initiative to communicate with patients' families and give them encouragement and spiritual support. Timely counseling was provided for patients with negative emotions such as irritability and anxiety. In addition, disease health education for patients and their families is strengthened to help patients develop good living and eating habits and improve their health after discharge. (5) The nursing staff kept the environment of the ward clean and hygienic, played relaxed and pleasant light music or the patient's favorite music and TV entertainment programs in the wardand read books and newspapers for the patient.

Research group: On top of the control group, grind rhubarb into powder, add appropriate amount of water and mix it thoroughly and apply it on the patient's patient's acupoints. Shenque, Tianshu, Guanyuan, Qihaiand Zhongwan acupoints were selected for application; the acupoint application therapy lasted for 4-6 hours, once a day for 5 days.

Follow-up investigation

All patients underwent a 6-month telephone follow-up after treatment and FGID recurrence was recorded. Any clinical symptoms of FGID in patients were defined as recurrence.

Endpoints

Statistical analysis was conducted on the time of abdominal distension relief, bowel sounds recovery and anal exhaust, as well as the degree of gastrointestinal injury before and after treatment with reference to the Acute Gastrointestinal Injury (AGI) classification (Reintam Blaser *et al.*, 2012): normal gastrointestinal function with no obvious symptoms and signs is rated as grade I; mild diarrhea or nausea, with no need for special treatment are classified as grade II; obvious symptoms such as diarrhea, vomiting and abdominal pain that require active treatment are classified as grade III. The gastric fluid of patients before and after treatment was drawn and the pH value was measured using a fully automatic blood gas analyzer. The intravesical pressure was measured using the intravesical pressure measurement method: a urinary catheter was inserted into the bladder and a certain size of saline was injected on the basis of emptying the bladder of urine and a pressure sensor was connected to the other end to measure the value. In addition, 3 mL of fasting venous blood was collected from patients before and after treatment and the serum was centrifuged (3000 rpm/min, 10) min after 30 min of standing at room temperature and D-lactic acid was detected by enzyme linked immunosorbent assay and Transferrin (TRF) was detected by protein detector, D-lactic acid was detected by enzyme linked immunosorbent assay and Transferrin (TRF), Prealbumin (PA) and Total protein (TP) were detected by protein detector. Nutrition Risk Screening (NRS2002) (Kondrup *et al.*, 2003) to investigate the malnutrition risk level of patients. Complications during the patients' treatment were counted and a 6-month prognostic follow-up (conducted using periodic review) was performed after the patients were discharged from the hospital to count the recurrence of FGID within 6 months of the patients' prognosis.

STATISTICAL ANALYSIS

This study employed SPSS24.0 for statistical analysis. Count data, expressed as [n(%)], were compared using chi-square tests. The ($\bar{\chi}\pm s$) was used to describe the measurement data and independent sample t tests and paired t tests were used for inter-group and intra-group

comparisons, respectively. The presence of statistical significance was indicated by P<0.05.

RESULTS

Comparison of symptom improvement time

The time for relief of abdominal distension, recovery of bowel sounds and anal exhaust in the research group were (3.20±0.40) d, (1.94±0.31) d and (2.46±0.65) d, respectively, all which were significantly shortened compared to the control group (P<0.05, table 2).

Comparison of gastrointestinal function

The two groups were similar in the degree of gastrointestinal function damage before treatment (P>0.05), with grade II injury being the dominant. Both groups showed a reduction in the number of grade III patients and an increase in the number of grade I patients, with fewer grade III cases and more grade I cases in the research group compared to the control group (P<0.05). Next, we found no statistical inter-group differences were found in abdominal pressure, gastrointestinal mucosal pH and D-lactic acid before treatment (P>0.05). After treatment, the gastrointestinal mucosal pH value of both groups increased, but with no significant difference between groups (P>0.05); the abdominal pressure and D-lactic acid in the research group decreased to (8.98±2.59) kPa and (14.73±3.26) mg/L, respectively, which were lower than those in the control group (P<0.05) (table 3).

Comparison of nutritional status

There was no significant difference in nutritional proteins between the two groups before treatment (P>0.05). TRF, PA and TP in both groups increased after treatment, especially in the research group (P<0.05). Meanwhile, the NRS2002 survey results showed that the research group had a lower risk of malnutrition after treatment (P<0.05, table 4).

Comparison of complications

According to the statistics of complications during the treatment process, both groups experienced symptoms such as diarrhea and fever, with an incidence of 10.00% in the research group and 12.00% in the control group, showing no marked inter-group difference (P>0.05) (table 5).

Comparison of nursing satisfaction and prognostic recurrence

The prognostic follow-up showed that the recurrence rate of FGID in the research group at 6 months was 10%, which was lower than that in the control group (P<0.05) (fig. 1).

DISCUSSION

In this study, we found in the comparison of gastrointestinal function that the time of symptom improvement in the research group was significantly shortened compared to the control group after treatment and the degree of gastrointestinal function damage, abdominal pressure and D-lactic acid were all reduced. The main components of rhubarb are emodin and isoernodin, as well as aloe-emodin and tannic acid. This medicine can obviously improve the gastrointestinal tract of patients, while exerting little influence on other organs of the body, with a high safety profile (Yang *et al.*, 2016). This can also be confirmed by the absence of statistical difference when we compared the incidence of complications between the two groups. Meanwhile, the research by Yao *et al*. indicates that rhubarb has obvious advantages in protecting the gastrointestinal mucosal barrier and reducing mucosal permeability, thus further improving intestinal mucosal blood perfusion (Yao *et al.*, 2015). In addition, rhubarb can inhibit bacterial overgrowth and intestinal endotoxin absorption in the gastrointestinal tract, scavenge oxygen free radicals and ultimately reduce systemic inflammation in patients (Tan *et al.*, 2019). These positive effects can promote gastrointestinal peristalsis and mucosal digestion and absorption and better improve the gastrointestinal secretion function of patients. However, TCM pharmacological research has also pointed out that long-term use of rhubarb may lead to excessive secretion of gastrointestinal mucus, which may cause adverse reactions such as diarrhea and bloating (Ma *et al.*, 2021). But the use of acupoint application makes it possible to avoid this toxic and side effect while allowing for the drug to concentrate locally, further accelerating the decrease of intestinal edema and ultimately enhancing gastrointestinal function.

In the subsequent comparison of nutritional status, the nutritional proteins in the research group were higher than those in the control group and the risk level of malnutrition was reduced. It can be seen that rhubarb acupoint application plus health management has a more significant effect on improving the nutritional status of FGID patients. As mentioned earlier, the combination of rhubarb acupoint application and health management can significantly improve the gastrointestinal function of FGID patients. At the same time, the stilbene acid, flavonoids, anthraquinones, minerals and vitamins rich in rhubarb have a direct impact on improving human nutritional status (Gu *et al.*, 2022). Gao *et al*. also pointed out that rhubarb has a bidirectional regulatory effect on microcirculation, which can not only stop bleeding, promote blood circulation and lower blood lipids, but also promote the transformation of human T lymphocytes, enhance the phagocytosis of macrophages and improve immune circulation (Gao *et al.*, 2021). Based on the above results, the use of rhubarb can provide a more reliable guarantee for the health and rehabilitation of patients. We believe that this is also the reason why the nursing satisfaction of the research group was higher and the recurrence rate of FGID was lower. Moreover, in a recent study of health food by Dai *et al*., they found that rhubarb is rich in a variety of nutrients and can provide a sufficient source of nutrients for the human body when used as a food additive (Dai *et al.*, 2021).

Table 1: Comparison of clinical data

		Control group (n=50)	Research group (n=50)	c^2 (or t)	P
Sex	Male	34 (68.00)	29 (58.00)	1.073	0.300
	Female	16 (32.00)	21 (42.00)		
Age		42.76±6.31	41.46±6.24	1.035	0.303
Duration of disease (h)		10.02±4.62	10.52±3.64	0.601	0.549
Chronic smoking	Yes	27 (54.00)	30 (60.00)	0.367	0.545
	No	23 (46.00)	20 (40.00)		
Chronic drinking	Yes	20 (40.00)	20 (40.00)	1.000	1.000
	No	30 (60.00)	30 (60.00)		
Body mass index (kg/m^2)		21.76±2.51	22.10±1.70	0.807	0.422

Table 2: Comparison of symptom improvement time

Groups	Relief of abdominal distension time (d)	Recovery of bowel sounds time (d)	Anal exhaust time (d)
Control group (n=50)	4.16±0.58	2.64±0.48	3.08±0.27
Research group (n=50)	3.20±0.40	1.94±0.31	2.46±0.65
t	9.557	8.571	6.251
P	<0.001	<0.001	<0.001

Table 3: Comparison of gastrointestinal function

		Control group (n=50)	Research group (n=50)	c^2 (or t)	P
Grade I	Before treatment	12 (24.00)	15 (30.00)	0.457	0.499
	After treatment	23 (46.00)*	22 (44.00)*	0.04	0.841
Grade II	Before treatment	15 (30.00)	13 (26.00)	0.198	0.656
	After treatment	18 (36.00)	30 (60.00)*	5.769	0.016
Grade III	Before treatment	25 (50.00)	15 (30.00)	4.167	0.041
	After treatment	7 (14.00)*	5 (10.00)*	0.379	0.538
Abdominal pressure (kPa)	Before treatment	12.20±3.06	12.24±3.58	0.06	0.952
	After treatment	10.38±3.56*	8.98±2.59*	2.25	0.027
Gastrointestinal mucosal pH	Before treatment	7.34±0.16	7.32±0.20	0.502	0.617
	After treatment	7.76±0.16*	7.81±0.20*	1.418	0.159
D-lactic acid (mg/L)	Before treatment	25.76±5.89	25.25±4.95	0.471	0.639
	After treatment	17.80±4.61*	14.73±3.26*	3.844	<0.001

Note: * means P<0.05 compared to before treatment.

Table 4: Comparison of nutritional status

		Control group (n=50)	Research group (n=50)	c^2 (or t)	P
TRF (g/L)	Before treatment	2.61±0.45	3.03±0.42	0.114	0.909
	After treatment	2.62±0.59*	3.32±0.29*	4.187	<0.001
PA (mg/L)	Before treatment	297.43±24.91	299.63±32.10	0.383	0.702
	After treatment	339.47±32.77*	361.66±24.31*	3.847	<0.001
TP (g/L)	Before treatment	63.21±10.68	63.38±7.25	0.096	0.923
	After treatment	70.90±8.19*	76.57±6.05*	3.942	<0.001
NRS2002	No-risk	6 (12.00)	7 (14.00)	0.088	0.766
	Low-risk	13 (26.00)	23 (46.00)	4.340	0.037
	Medium-risk	16 (32.00)	11 (22.00)	1.268	0.260
	High-risk	15 (30.00)	9 (18.00)	1.974	0.160

Note: * means P<0.05 compared to before treatment.

Table 5: Comparison of complications

Groups	Diarrhea	Fever	Rash	Dizziness/headache	Total Incidence
Control group (n=50)	2 (4.00)	2 (4.00)	1 (2.0)	1 (2.0)	6 (12.00)
Research group (n=50)	2 (4.00)	1 (2.0)	1 (2.0)	1 (2.0)	5 (10.00)
χ^2					0.102
P					0.749

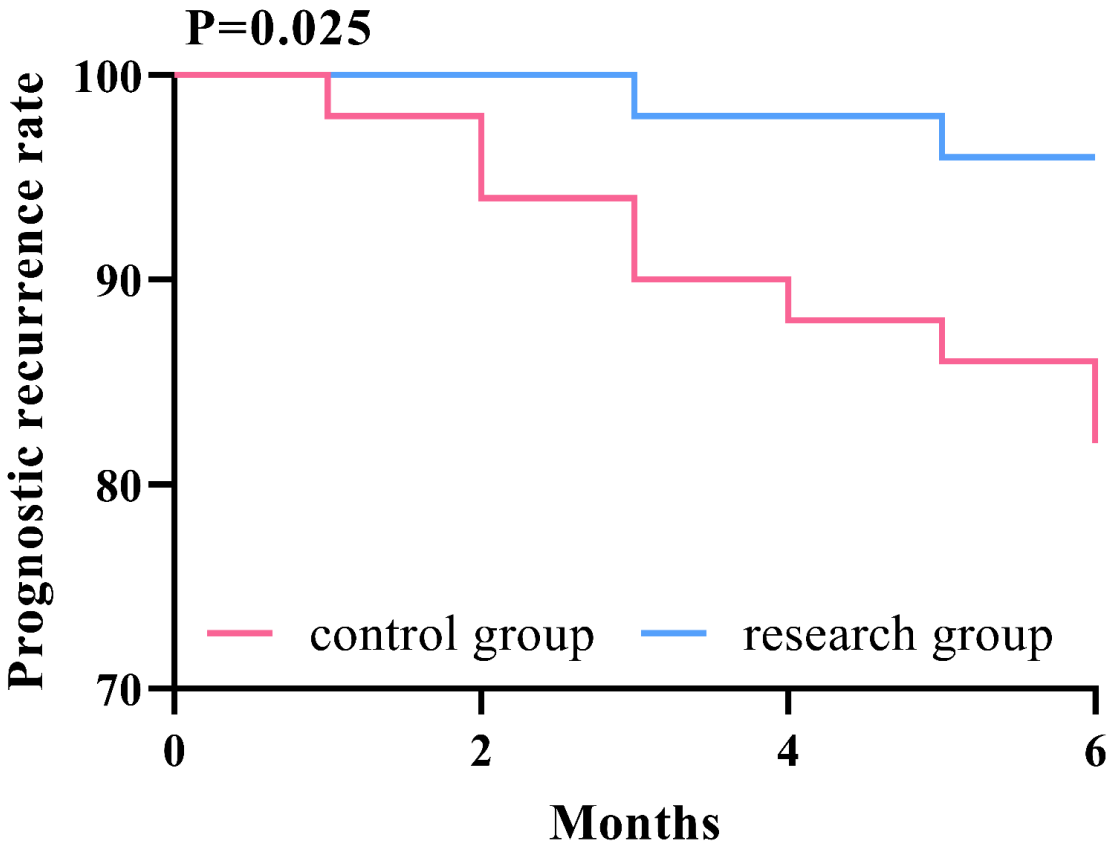

Fig. 1: Comparison of prognostic recurrence rates.

Of course, we cannot ignore the positive impact of targeted health management on patients. Research has shown that conventional FGID management lacks specificity and personalized treatment for patients, making it difficult to achieve the goal of improving clinical treatment effectiveness (Goyal *et al.*, 2021). The health management model proposed in this study is a functional nursing scheme, which timely repairs and restores the intestinal mucosa through comprehensive nutritional support, maintains the intestinal barrier function to a certain extent and enables the body to obtain strong immunity. Besides, the model focuses on patient comfort and relieves patient pain by providing an appropriate environment, early intervention, pain management psychological support and other comprehensive measures. Similarly, Cushing *et al.* agree that health management for patients with Crohn's disease is more helpful in improving patient prognosis (Cushing & Higgins, 2021), which is consistent with our view. Of course, we also need to include more cases and extend the follow-up period to further validate our viewpoint.

To sum up, rhubarb can effectively improve the gastrointestinal function of FGID patients, improve their nutritional status and promote the comprehensive recovery of their physical health. Moreover, this treatment scheme has a very high safety profile and can provide a more reliable safety guarantee for the prognosis and health of patients, so it is recommended for clinical use.

Availability of data and materials

Original data in this study are available from the corresponding author on reasonable requests.

Conflicts of Interest

The authors report no conflict of interest.

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