Effects of Visceral Manipulation on Inflammatory Stress and Prognosis in Patients Undergoing Gastrointestinal Surgery

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Abstract [**Objectives**] To investigate the effects of Visceral Manipulation combined with Enhanced Recovery after Surgery on postoperative recovery in patients undergoing gastrointestinal surgery, and to evaluate its impacts on inflammatory stress response, gastrointestinal motility recovery, and blood oxygen levels. [**Methods**] A prospective randomized controlled design was adopted. Eighty patients undergoing gastrointestinal surgery from January 2022 to December 2023 were selected and randomly divided into an observation group (40 cases) and a control group (40 cases). The observation group received Visceral Manipulation therapy in addition to routine Enhanced Recovery after Surgery care, while the control group received only routine Enhanced Recovery after Surgery care. Clinical indicators, inflammatory factors (TNF-α, IL-6, hs-CRP), traumatic stress hormones (cortisol, epinephrine, norepinephrine), gastrointestinal motility indicators (GAS, MTL, GIP), and blood oxygen levels were measured and compared between the two groups on postoperative days 1, 5, and 10. [**Results**] The observation group showed significantly better outcomes in postoperative abdominal distension, time to first flatus and defecation, and hospital stay compared to the control group ($P<0.05$). Inflammatory factors (TNF-α, IL-6, hs-CRP), traumatic stress hormones (cortisol, epinephrine, norepinephrine), and gastrointestinal motility indicators (GAS, MTL, GIP) were significantly improved in the observation group ($P<0.05$). Postoperative blood oxygen levels were also significantly higher in the observation group ($P<0.05$). [**Conclusions**] Visceral Manipulation combined with Enhanced Recovery after Surgery can significantly improve postoperative recovery in gastrointestinal surgery patients, alleviate inflammatory stress responses, promote gastrointestinal functional recovery, and enhance blood oxygen levels, demonstrating promising clinical application prospects.

Key words Visceral Manipulation, Gastrointestinal surgery, Inflammatory stress, Gastrointestinal motility, Blood oxygen level

1 Introduction

With the continuous development of socioeconomics and improvement in living standards, the incidence of gastrointestinal diseases has been increasing annually. Particularly, the high prevalence of conditions such as gastrointestinal tumors has made gastrointestinal surgery a common treatment approach[1]. According to clinical observations, postoperative abdominal distension remains one of the most frequent symptoms, affecting approximately 60% - 80% of gastrointestinal surgery patients. If not promptly addressed, severe cases may negatively impact long-term prognosis[2]. It has become particularly crucial to explore novel methods that not only accelerate recovery but also effectively alleviate postoperative complications. The introduction of the Enhanced Recovery after Surgery (ERAS) concept has provided new perspectives for perioperative management in surgical patients[3]. Visceral Manipulation not only effectively alleviates symptoms like postoperative abdominal distension and difficulty in gas expulsion but also regulates systemic inflammatory stress responses and improves postoperative recovery outcomes.

2 Research objects and methods

2.1 Research objects The research objects were 80 patients who underwent gastrointestinal surgery from January 2022 to December 2023. All patients were from the gastrointestinal surgery department of a hospital. All patients met the inclusion criteria.

2.2 Grouping According to the treatment protocol, all patients were randomly divided into two groups, with 40 cases in each group. Patients in the observation group received Visceral Manipulation combined with Enhanced Recovery after Surgery care, while those in the control group received only conventional Enhanced Recovery after Surgery care. After surgery, all patients were managed according to the hospital's standardized nursing procedures and then randomly assigned to either the observation group or the control group.

Observation Group: In addition to routine Enhanced Recovery after Surgery care postoperatively, patients underwent Visceral Manipulation therapy. Treatment commenced on the first postoperative day, with manual techniques performed by rehabilitation therapists tailored to each patient's condition. Each session lasted 15 min, administered 3 - 5 times per week until symptom relief.

Control Group: Patients received only conventional Enhanced Recovery after Surgery care, including early oral feeding, limb activity training, warming care, and other measures, but excluding Visceral Manipulation.

2.3 Indicator detection The following indicators were primarily examined to evaluate the rehabilitation effects of Visceral Manipulation in gastrointestinal surgery patients. Abdominal distension severity: patients were categorized into mild, moderate, and severe groups based on postoperative abdominal distension severity. Symptoms were scored on postoperative day 5, and the degree of symptom relief was recorded. Time to first flatus: the time to first postoperative flatus (expressed in hour) was documented to assess gastrointestinal motility recovery. Time to first defecation:

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the time to first postoperative defecation (expressed in hour) was recorded to evaluate functional recovery of the gastrointestinal tract. Hospital stay duration: the total postoperative hospitalization days were documented to assess the impact of accelerated recovery protocols on hospital stay. Tumor necrosis factor-α (TNF-α): the TNF-α levels of the serum were measured using the enzyme-linked immunosorbent assay (ELISA) method to evaluate postoperative inflammatory responses. Interleukin-6 (IL-6): serum IL-6 concentrations were similarly quantified via ELISA to assess changes in inflammatory factors. High-Sensitivity C-Reactive Protein (hs-CRP): hs-CRP levels were measured by ELISA to reflect postoperative inflammatory reactions. Cortisol (Cor): As a critical stress hormone, cortisol levels were analyzed via ELISA using postoperative blood samples to evaluate surgical stress responses. Epinephrine (E): Serum epinephrine levels were measured postoperatively to assess trauma-induced stress reactions. Norepinephrine (NE): norepinephrine concentrations, pivotal in postoperative stress responses, were detected by ELISA to quantify trauma-related stress. Gastrin (GAS): preoperative and postoperative gastrin levels were measured via ELISA to evaluate gastrointestinal motility recovery. Motilin (MTL): motilin concentrations were analyzed by ELISA to reflect gastrointestinal motor function. Gastric inhibitory peptide (GIP): GIP levels were assessed to determine the physiological status and postoperative recovery of the gastrointestinal tract. Oxygen saturation (SpO_2): SpO_2 levels were measured preoperatively and on postoperative day 5 using a pulse oximeter to assess respiratory function and oxygenation status.

2.4 Data processing SPSS 21.0 statistical software was employed for data processing. Enumeration data were expressed as percentages and differences between groups were analyzed using the chi-square test (χ^2 test). Measurement data were expressed as mean ± standard deviation ($\bar{x} \pm s$), and independent sample t test was used for group comparison. $P < 0.05$ indicates a statistically significant difference.

3 Results and analysis

3.1 Comparison of general data In this study, a total of 80 patients were included in the analysis, with 40 cases each in the observation group and the control group. The two groups showed no significant differences in age, gender, body mass index (BMI), smoking history, alcohol consumption, hypertension, hyperlipidemia, or diabetes mellitus, indicating comparable baseline characteristics between the groups (Table 1). Additionally, all patients received standardized preoperative treatment and signed informed consent forms.

Table 1 Comparison of general data of patients in the two groups ($n = 40$)

Group	Age years old	Gender male/female	BMI kg/m^2	Smoke Y/N	Drinking Y/N	Hypertension Y/N	Hyperlipidemia Y/N	Diabetes Y/N
Observation	38.89 ± 7.56	27/13	24.37 ± 2.55	18/22	14/26	6/34	2/38	1/39
Control	39.05 ± 8.02	23/17	23.94 ± 2.43	14/26	12/28	4/36	3/37	0/40
χ^2/t value	0.092	0.853	0.772	0.833	0.228	0.457	0.213	1.013
P value	0.927	0.356	0.442	0.361	0.633	0.499	0.644	0.314

NOTE Y means Yes, and N denotes No.

3.2 Postoperative recovery Postoperative recovery is an important indicator to evaluate the effect of surgery and rehabilitation process.

According to Table 2, the postoperative recovery of the observation group was significantly better than that of the control group. Specifically, the observation group showed significantly milder abdominal distension symptoms, shorter time to first flatus and time to first defecation, as well as a notably reduced hospital stay compared to the control group ($P < 0.05$). These results reveal that Visceral Manipulation demonstrates significant advantages in accelerating postoperative recovery and reducing complications for patients.

Table 2 Comparison of postoperative recovery ($n = 40$)

Group	Abdominal distension 5 d after operation	Time to first flatus//h	Time to first defecation//h	Hospital stay//d
Observation	Mild (30 cases)	24.2 ± 6.3	48.1 ± 9.2	6.3 ± 2.4
Control	Moderate and severe (25 cases)	36.1 ± 8.7	60.5 ± 10.3	8.7 ± 3.1
t value	3.67	5.92	4.17	4.31
P value	< 0.001	< 0.001	< 0.001	< 0.001

3.3 Changes in levels of inflammatory factors The changes in inflammatory factors after operation reflect the level of inflammatory reaction during the recovery process. Table 3 shows the changes in the levels of inflammatory factors before and after the operation in the two groups.

The results showed that the levels of TNF-α, IL-6 and hs-CRP in the observation group after operation were significantly lower than those before operation, and the levels after operation were

Table 3 Changes in inflammatory factors before and after operation

Group		TNF-α//pg/mL	IL-6//pg/mL	hs-CRP//mg/L
Observation	Before operation	13.2 ± 3.4	12.5 ± 3.1	5.1 ± 1.2
	After operation	9.5 ± 2.3	8.7 ± 2.1	2.8 ± 1.1
Control	Before operation	14.1 ± 3.8	13.2 ± 3.4	5.3 ± 1.4
	After operation	12.3 ± 3.0	11.4 ± 2.7	4.7 ± 1.3
t value		3.49	3.29	2.68
P value		< 0.001	< 0.001	0.009

lower than those in the control group ($P < 0.05$). This finding suggests that Visceral Manipulation can effectively reduce the postoperative inflammatory response and reduce the related physiological burden.

3.4 Changes in traumatic stress indicators The impact of traumatic stress response on postoperative recovery in patients cannot be overlooked. Table 4 displays changes in preoperative and postoperative traumatic stress indicators (cortisol, epinephrine, norepinephrine) between the two groups.

Table 4 Changes in traumatic stress indicator before and after operation

Group		Cor//nmol/L	E//pmol/L	NE//pmol/L
Observation	Before operation	300.2 ± 50.4	650.5 ± 72.3	220.1 ± 35.6
	After operation	210.3 ± 30.2	500.4 ± 60.1	190.3 ± 32.5
Control	Before operation	310.1 ± 60.3	660.2 ± 80.5	225.5 ± 38.1
	After operation	270.1 ± 40.3	590.5 ± 70.2	210.4 ± 35.9
t value		4.14	4.45	3.91
P value		< 0.001	< 0.001	< 0.001

The data indicate that postoperative cortisol, epinephrine, and norepinephrine levels in the observation group were significantly lower than those in the control group ($P < 0.05$), demonstrating that Visceral Manipulation can effectively alleviate postoperative traumatic stress responses, thereby further promoting postoperative recovery.

3.5 Changes in gastrointestinal motility indicators The recovery of gastrointestinal motility is an important indicator of postoperative rehabilitation. Table 5 shows the changes in gastrointestinal motility related indicators (gastrin, motilin and gastric inhibitory peptide) before and after operation in the two groups.

Table 5 Changes in gastrointestinal motility indicators before and after operation pg/mL

Group		GAS	MTL	GIP
Observation	Before operation	56.3 ± 10.4	42.1 ± 9.6	35.2 ± 8.2
	After operation	42.5 ± 8.9	32.5 ± 6.3	28.1 ± 5.6
Control	Before operation	57.4 ± 11.0	43.2 ± 10.4	36.1 ± 8.5
	After operation	50.1 ± 9.2	37.8 ± 7.1	30.5 ± 6.8
t value		4.28	3.71	3.94
P value		< 0.001	< 0.001	< 0.001

The recovery of gastrin (GAS), motilin (MTL) and gastric inhibitory peptide (GIP) in the observation group was significantly better than that in the control group ($P < 0.05$), demonstrating that Visceral Manipulation was helpful to accelerate the recovery of gastrointestinal motility.

3.6 Changes in blood oxygen levels Postoperative blood oxygen level is an important physiological index to evaluate the recovery of patients. Table 6 shows the changes of oxygen saturation before and after the operation in both groups. The postoperative blood oxygen level in the observation group was significantly higher than that in the control group, indicating that Visceral Manipulation played a positive role in improving the postoperative oxygenation status of patients. The significant improvement in blood oxygen levels after surgery further suggests that Visceral Manipulation helps to improve the patient's respiratory function and oxygenation status.

Table 6 Changes in blood oxygen levels before and after operation %

Group		Pre-blood oxygen	Post-blood oxygen
Observation	Before operation	92.5 ± 3.4	95.2 ± 2.2
	After operation	96.1 ± 2.1	97.8 ± 1.9
Control	Before operation	93.2 ± 3.1	94.6 ± 3.2
	After operation	94.3 ± 3.0	96.1 ± 2.3
t value		2.94	3.78
P value		0.004	< 0.001

4 Discussion

After gastrointestinal surgery, symptoms such as abdominal distension, difficulty in passing gas, and difficulty in defecation are common complications during postoperative recovery, affecting patients' rehabilitation speed and quality of life[4]. Traditional rehabilitation methods, such as oral herbal medicine and foot massage, although showing certain efficacy, are often insufficient to fully alleviate these symptoms and have limited effects on restoring gastrointestinal function. As an emerging therapeutic approach, Visceral Manipulation accelerates gastrointestinal recovery by manually adjusting the mobility of visceral organs, reducing postoperative adhesions and functional impairments. The results of this study demonstrate that postoperative abdominal distension in the observation group was significantly milder than in the control group, with notably shorter times to gas passage and defecation ($P < 0.05$). These findings are consistent with reports in relevant literature regarding the positive impact of Visceral Manipulation on gastrointestinal function[5]. Postoperative inflammatory stress response is one of the critical factors influencing patient recovery. Excessive inflammatory reactions not only prolong recovery time but may also lead to severe complications such as infections and visceral organ failure. Therefore, controlling inflammatory responses is essential for accelerating postoperative recovery. This study found that postoperative levels of inflammatory factors such as TNF-α, IL-6, and hs-CRP in the observation group were significantly lower than those in the control group ($P < 0.05$), indicating that Visceral Manipulation effectively mitigates postoperative inflammatory responses. This outcome may be attributed to Visceral Manipulation improving visceral blood flow mobility, reducing tissue hypoxia, and promoting the clearance of metabolic byproducts. Research suggests that Visceral Manipulation reduces visceral inflammatory responses by enhancing organ movement and restoring physiological states[6]. Postoperative blood oxygen level recovery is a vital indicator for assessing patient recovery. Improved blood oxygen saturation reflects enhanced oxygenation status and respiratory function. Low postoperative blood oxygen levels may cause tissue hypoxia, delaying wound healing and recovery processes. The results of this study show that postoperative blood oxygen levels in the observation group were significantly higher than those in the control group ($P < 0.05$), demonstrating that Visceral Manipulation aids in improving postoperative blood oxygen levels. By enhancing visceral organ mobility and blood flow, Visceral Manipulation likely increases tissue oxygen supply and optimizes patients' oxygenation status. Similar studies indicate that Visceral Manipu-

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the internationally recognized PSQI, the study found that the combined therapy group showed significantly greater PSQI score reductions than the control group after 2 weeks ($P < 0.01$), with marked improvements in key dimensions such as shortened sleep latency, prolonged deep sleep duration, and enhanced daytime function. Modern research further suggests that the combined therapy acts through multiple pathways: regulating neurotransmitters like γ-aminobutyric acid (GABA) and serotonin (5-HT) to enhance central inhibition; modulating the hypothalamic-pituitary-adrenal (HPA) axis to alleviate stress; promoting melatonin secretion to adjust circadian rhythms; improving heart rate variability (HRV) to balance autonomic nervous function; and enhancing systemic immunity through localized herbal penetration that regulates qi and blood.

In summary, the head massage and Chinese herbal bath therapy, rooted in TCM theory, offers advantages of safety, convenience, cost-effectiveness, and proven efficacy. It is particularly suitable for populations with functional disorders such as chronic insomnia, fatigue, and neurasthenia. Future integration with evidence-based medical methods to optimize therapeutic regimens and quantify outcomes may establish a novel, efficient, and sustainable TCM approach for insomnia treatment.

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lation promotes tissue oxygenation by regulating the autonomic nervous system and hemodynamics, thereby accelerating postoperative recovery[7]. As a novel adjuvant therapy, Visceral Manipulation holds broad application prospects in Enhanced Recovery after Surgery.

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