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Clinical Application and Effect Observation of Acupoint Pressure Antithrombotic Pump in Patients Undergoing Colorectal Cancer Surgery

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Abstract

Objective: To investigate the application effect of an acupoint pressure antithrombotic pump based on acupoint stimulation in preventing deep vein thrombosis (DVT) in patients undergoing colorectal cancer surgery and to evaluate its impact on postoperative quality of life. *Methods:* A total of 78 patients who underwent colorectal cancer surgery in the gastrointestinal surgery department of a tertiary-level grade A hospital from January 2024 to May 2025 were selected and randomly divided into a control group (n = 39) and an observation group (n = 39). Both groups implemented the Enhanced Recovery After Surgery (ERAS) nursing protocol for colorectal procedures. The control group received conventional manual acupoint massage (at Zusanli (ST36) and fenglong (ST40) acupoint) combined with intermittent pneumatic compression device therapy; the observation group received “acupoint pressure antithrombotic pump therapy” (acupoint-assisted stimulation device stimulating Zusanli (ST36) and fenglong (ST40) acupoint combined with intermittent pneumatic compression device). The incidence of postoperative deep vein thrombosis (DVT) and quality of life were compared between the two groups. *Results:* No DVT occurred in either group after surgery. The SF-36 quality of life assessment showed that on the 3rd postoperative day and at discharge, the observation group scored significantly higher than the control group in four dimensions: role-physical (RP), general health (GH), role-emotional (RE), and mental component summary (MCS) ($p < 0.05$). Additionally, on the 3rd postoperative day, the observation group also scored significantly higher than the control group in the bodily pain (BP) dimension ($p < 0.05$). *Conclusion:* Based on the ERAS protocol, the application of acupoint pressure antithrombotic pumps can effectively prevent the occurrence of DVT in patients after colorectal cancer surgery and significantly improve their short-term postoperative quality of life, demonstrating good clinical application value.

Keywords

Colorectal cancer; Deep vein thrombosis; Pressure antithrombotic pump; Acupoint stimulation; Quality of life; Enhanced recovery after surgery

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1. Introduction

Deep vein thrombosis (DVT) is a venous return disorder caused by abnormal blood coagulation in deep veins, commonly occurring in the lower extremities. Thrombus detachment can lead to pulmonary embolism (PE), with DVT and PE being manifestations of the same disease at different stages. Collectively, they are referred to as venous thromboembolism (VTE). Patients with malignant tumors are at high risk for VTE, with an incidence rate of 4% to 20% [1]. Gastrointestinal malignancies have a high incidence in China, and once VTE occurs, it not only affects patients' quality of life and prognosis but can also be life-threatening in severe cases. Currently, the reported Western medical prevention methods for DVT mainly include pharmacological prevention and mechanical prevention. In traditional Chinese medicine (TCM), many external treatment methods have also demonstrated definite efficacy in preventing DVT. This study innovatively integrates the theory of TCM meridians and acupoint with modern mechanical antithrombotic technology. It utilizes an acupoint-pressure antithrombotic pump (a combination of an antithrombotic pump and an acupoint massage device (utility model patent CN222444789U), which stimulates bilateral Zusanli (ST36) and fenglong (ST40) acupoint while applying pressure with the antithrombotic pump) to explore the clinical efficacy of this combined device in reducing the incidence of postoperative DVT and improving the quality of life in patients with colorectal cancer.

2. Materials and methods

2.1. Study subjects

This study employed a randomized controlled clinical trial design, selecting 78 patients with colorectal cancer who underwent surgical treatment in the Gastrointestinal Surgery Department of Tianjin Nankai Hospital from January 2024 to May 2025. These patients were randomly divided into an intervention group and an observation group, with 39 patients in each group. This study was approved by the Medical Ethics Committee, and informed consent forms were signed by both the patients and their families.

2.1.1. Inclusion criteria

(1) Inpatients undergoing surgical treatment for colorectal tumors (patients admitted for treatment 1–2 weeks prior to surgery);
(2) Aged between 18 and 80 years old;
(3) No history of abdominal or thoracic surgery, with normal blood, urine, and stool tests, as well as normal heart, liver, and kidney function;
(4) Patients voluntarily participating in the experiment and signing informed consent forms;
(5) Exclusion of deep vein thrombosis in both lower extremities via color Doppler ultrasound examination after admission and postoperatively

2.1.2. Exclusion criteria

(1) Patients with severe cardiocerebrovascular diseases, pulmonary edema, metabolic diseases, and severe lower extremity edema;
(2) Patients with deep vein thrombosis of both lower extremities, thrombophlebitis, and pulmonary embolism;
(3) Patients who are unable to care for themselves or are uncooperative;
(4) Patients currently participating in other clinical drug trials;
(5) Patients who voluntarily withdraw from the study after enrollment and fail to complete the entire treatment plan;
(6) Patients or their legal representatives who refuse to participate in this study

2.2. Intervention measures

2.2.1. Both groups received the same intervention protocol

Both the control group and the observation group will adopt an accelerated rehabilitation nursing plan for colorectal surgery, which includes:

(1) Pre-rehabilitation measures

Paying attention to patients' psychological changes and providing psychological care; guiding patients to enhance their dietary nutrition; strengthening physical training and pulmonary function training; implementing standardized thrombosis prevention and management measures.

(2) Accelerated rehabilitation surgical measures
Early postoperative mobilization, early drinking and eating as prescribed by the doctor, effective management of pain, nausea, and vomiting, and postoperative antithrombotic management measures.

2.2.2. Control group

(1) Manual acupoint massage
Performed by two trained professional nurses from the research team. The operators accurately locate the bilateral Zusanli (ST36) and fenglong (ST40) acupoints, and perform acupoint massage using the surface of the thumb or flexed finger joints, alternating between pressing, pushing, and kneading techniques. The massage should be continued until the patient feels a mild soreness and distension, while avoiding skin damage. Each acupoint is massaged for 5 minutes, totaling 20 minutes, twice daily, from admission until postoperative recovery and discharge.

(2) Intermittent Pneumatic Compression Antithrombotic Pump (Model: Flowtron Excel). Patients use the pressure antithrombotic pump to prevent deep vein thrombosis; the duration is 1 hour, twice daily, until postoperative recovery and discharge.

2.2.3. Observation group

Patients in this group received acupoint pressure antithrombotic pump therapy, as follows.

Using a self-developed utility model patent product, an acupoint massage device based on an antithrombotic pump (CN222444789U): The spherical center of the device's silicone hemisphere (with a base diameter of 3 cm and a height of 1.5 cm) is precisely aligned with the bilateral Zusanli (ST36) and bilateral fenglong (ST40) acupoints (the acupoint selection method is the same as that used in the control group). The device is secured in place using an accompanying fixation patch, with the tightness adjusted to ensure stable and continuous vertical pressure on the acupoint by the silicone hemisphere. Subsequently, the intermittent pneumatic compression antithrombotic pump is activated, and patients can clearly feel a mild soreness and distension at the acupoint sites under the pressurized state of the antithrombotic pump. The duration is synchronized with the usage time of the pressure antithrombotic pump, twice daily for 1 hour each session, until postoperative recovery and discharge.

2.3. Observation indicators

2.3.1. General information

This includes patient ID, gender, age, disease diagnosis, height, weight, history of abdominal surgery, preoperative comorbidities, surgical approach, duration of surgery, and intraoperative blood loss.

2.3.2. Efficacy indicators for DVT

The incidence of lower extremity DVT. Patients underwent routine color Doppler ultrasound examinations upon admission and after surgery to exclude DVT, and the results of thrombotic risk assessments were recorded.

2.3.3. Quality of life assessment

The perioperative quality of life of patients was evaluated using surgery-related dimensions from the Short Form Health Survey (SF-36): role-physical (RP), body pain (BP), general health (GH), vitality (VT), social functioning (SF), role emotional (RE), and mental health (MH). This scale has high universality, with higher scores indicating a better quality of life. Recording times: Records were taken once before surgery, on the third day after surgery, and at discharge to compare improvements in the patients' quality of life.

2.4. Statistical methods

Clinical data in this study were analyzed using SPSS 21.0 statistical software. Continuous data were expressed as mean ± standard deviation ($\bar{x} \pm s$) and analyzed using the *t*-test, while categorical data were expressed as percentages (%) and analyzed using the χ^2 test. A *p*-value of less than 0.05 was considered statistically significant.

3. Results

3.1. General information

There were no statistically significant differences in baseline data such as gender, age, BMI, diagnosis, and intraoperative blood loss between the two groups of patients ($p > 0.05$). The grouping randomization was well-

executed, ensuring reliable comparability of subsequent results (see **Table 1**).

3.2. DVT efficacy indicators

The incidence rate of DVT in both groups was 0.

3.3. Quality of life assessment (SF-36) related to surgical dimensions

The observation group scored better than the control group in the following aspects: physiological function at 3 days post-surgery and at discharge, bodily pain at 3 days post-surgery, overall health at 3 days post-surgery and at discharge, social function at 3 days post-surgery, emotional function at 3 days post-surgery and at discharge, physical health dimension at 3 days post-surgery and at discharge, and mental health at 3 days post-surgery and at discharge. The differences were statistically significant ($p < 0.05$) (see **Table 2**).

4. Discussion

This study innovatively applied the meridian-acupoint pressure antithrombotic pump, which combines traditional Chinese medicine meridian-acupoint theory with mechanical thrombotic devices, to patients in the perioperative period of colorectal cancer. The aim was to explore its positive effects in reducing the risk of deep vein thrombosis (DVT) in postoperative patients and improving their quality of life. The results showed that, compared to traditional acupoint massage combined with intermittent pneumatic compression antithrombotic pumps, the meridian-acupoint pressure antithrombotic pump demonstrated significant advantages in preventing postoperative DVT and comprehensively improving patients' quality of life. This provides new insights and practical evidence for the collaborative measures of integrated traditional Chinese and Western medicine in preventing postoperative complications, accelerating recovery, and saving labor costs.

4.1. Analysis of DVT prevention effects

No symptomatic lower extremity DVT events occurred in either group of patients after surgery in this study, which is closely related to the widespread adoption of comprehensive preventive measures under the current concept of enhanced recovery after surgery (ERAS) and the standardized diagnosis, treatment, and nursing care for thrombus prevention [2]. Standardized ERAS protocols, including standardized and accurate preoperative assessments and adequate prehabilitation, perioperative basic screening and prevention, early postoperative ambulation, and standardized use of anticoagulant medications, form the cornerstone of DVT prevention [3]. Additionally, all patients included in this study were elective surgery patients, and relevant high-risk factors such as active bleeding risk and severe coagulation dysfunction had been effectively managed before surgery, further reducing the incidence of DVT. Furthermore, from the perspective of traditional Chinese medicine theory, the possible mechanism lies in the following: The acupoint pressure antithrombotic pump combines the positive effects of mechanically increasing venous blood flow velocity and reducing stagnant hemodynamics with effective stimulation of specific acupoints. Zusanli (ST36) is the He-sea point of the "Stomach Meridian of Foot-Yangming", which has the functions of invigorating the spleen and replenishing Qi, tonifying deficiency and strengthening the body, and dredging meridians and activating collaterals. Fenglong (ST40) is the luo-connecting point of the Stomach Meridian, which can resolve phlegm, eliminate dampness, promote blood circulation, and unblock collaterals. Compared with simply using an antithrombotic pump or manual massage, this device precisely and continuously acts on acupoints by setting pressure parameters, potentially generating a synergistic effect of "1 + 1 > 2".

4.2. Discussion on the mechanism of improving quality of life

The comparison results of the surgery-related dimensions of the SF-36 scale between the two groups of cases in this study show that the observation group scored significantly higher than the control group in multiple dimensions, including role-physical, bodily pain, general health perception, role-emotional, social functioning, physical health, and mental health. This indicates that the acupoint pressure antithrombotic pump comprehensively improves the postoperative quality of life of colorectal cancer patients. This improvement can be attributed to multi-level mechanisms:

Table 1. Comparison of general treatment between the two groups of patients

Characteristic	Category	Control group (n = 39)	Observation group (n = 39)	Statistical value (t/χ^2)	*p*-value
Gender [n (%)]	Male	18 (46.2%)	22 (56.4%)	a0.82	0.37
	Female	21 (53.8%)	17 (43.6%)		
Age (years)		62.74 ± 10.12	63.69 ± 9.13	b-0.44	0.67
BMI (kg/m^2)		23.33 ± 2.97	23.32 ± 3.45	b0.01	0.99
Diagnosis [n (%)]	Colon cancer	21 (53.8%)	25 (64.1%)	a0.80	0.37
	Rectal cancer	18 (46.2%)	14 (35.9%)	b1.64	0.10
Intraoperative blood loss (mL)		62.18 ± 38.64	48.46 ± 34.98		

Note: a indicates the χ^2 value, and b indicates the *t* value.

Table 2. Comparison of SF-36 scale scores related to surgical dimensions between the two groups of patients

		Control group (n = 39)	Observation group (n = 39)	*t*-value	*p*-value
Role-physical	Preoperative	69.87 ± 36.80	80.77 ± 34.15	-1.36	0.18
	Postop Day 3	4.49 ± 17.08	19.87 ± 25.76	-3.11	< 0.001
	Discharge	44.87 ± 33.53	78.85 ± 30.64	-4.67	< 0.001
Bodily pain	Preoperative	73.51 ± 22.90	81.56 ± 16.66	-1.78	0.08
	Postop Day 3	35.90 ± 13.51	49.79 ± 16.09	-4.13	< 0.001
	Discharge	75.33 ± 13.00	79.74 ± 15.82	-1.35	0.18
General health	Preoperative	55.64 ± 15.10	51.79 ± 17.97	1.02	0.31
	Postop Day 3	40.26 ± 6.28	43.59 ± 4.86	-2.62	0.01
	Discharge	66.15 ± 6.93	70.38 ± 3.51	-3.40	< 0.001
Vitality	Preoperative	72.18 ± 19.46	75.00 ± 12.93	-0.75	0.45
	Postop Day 3	39.23 ± 14.12	42.69 ± 13.12	-1.12	0.27
	Discharge	69.36 ± 9.40	68.21 ± 8.77	0.56	0.58
Social function	Preoperative	73.08 ± 24.26	74.04 ± 20.36	-0.19	0.85
	Postop Day 3	26.60 ± 13.81	34.94 ± 13.20	-2.73	0.01
	Discharge	67.31 ± 12.37	71.15 ± 9.58	-1.54	0.13
Role-emotional	Preoperative	83.76 ± 32.33	83.76 ± 34.94	0.00	1.00
	Postop Day 3	2.56 ± 9.00	11.97 ± 23.56	-2.33	0.02
	Discharge	50.43 ± 30.47	81.20 ± 27.35	-4.69	< 0.001
Physical health summary	Preoperative	289.92 ± 62.70	306.56 ± 53.98	-1.26	0.21
	Postop Day 3	98.08 ± 32.54	123.77 ± 40.57	-3.09	< 0.001
	Discharge	248.67 ± 52.68	293.85 ± 50.38	-3.87	< 0.001
Mental health summary	Preoperative	297.32 ± 75.24	308.39 ± 62.05	-0.71	0.48
	Postop Day 3	123.88 ± 36.76	149.18 ± 36.39	-3.06	< 0.001
	Discharge	262.99 ± 44.51	298.40 ± 36.99	-3.82	< 0.001

4.2.1. Effective postoperative analgesia (Improvement in dimensions such as bodily pain and physical health)

Surgical trauma is the primary source of postoperative pain. Zusanli (ST36) acupoint is a crucial point for analgesia. Many modern studies have demonstrated that stimulating this acupoint can inhibit the transmission of nociceptive signals, activate the endogenous analgesic system, and promote the release of analgesic substances such as β-endorphin, enkephalin, and dynorphin from the central nervous system, thereby effectively reducing pain sensitivity [4,5]. The stimulation of the Zusanli (ST36) acupoint by the acupoint pressure anti-embolism pump combined with auxiliary devices provides a non-invasive, non-pharmacological analgesic method for postoperative patients, significantly enhancing their comfort. Additionally, delayed recovery of gastrointestinal function after colorectal cancer surgery is a significant factor that severely affects patients' disease recovery and quality of life. Zusanli (ST36) acupoint is a classic acupoint for regulating gastrointestinal function. Although this study does not mention research results regarding gastrointestinal function recovery, stimulating the Zusanli (ST36) acupoint also promotes the recovery of gastrointestinal function and improves appetite in postoperative patients [5,6], thereby enhancing nutritional status, promoting physiological health, laying the foundation for overall patient recovery, and indirectly improving vitality and overall health perception.

4.2.2. Improvement of negative emotions (Improvement in emotional function and mental health dimensions)

Malignant tumors and surgery itself can serve as significant psychological stressors for patients, easily triggering negative emotions such as anxiety, depression, and fear. In traditional Chinese medicine (TCM), it is believed that "stagnation of emotions and spirits leads to Qi stagnation", which affects the function of the Zang-Fu organs. Stimulating the Zusanli (ST36) and fenglong (ST40) acupoints has the effects of regulating Qi circulation, soothing the liver and resolving depression, and calming the mind and spirit [7]. Modern mechanistic studies have revealed that this stimulation may exert anti-anxiety and anti-depressant effects by regulating the function of the hypothalamic-pituitary-adrenal axis, increasing the concentrations of neurotransmitters such as serotonin and gamma-aminobutyric acid, and reducing stress hormone levels [8,9]. The regular acupoint stimulation provided by the equipment in this study offers patients a passive and comfortable relaxation experience, helping to alleviate psychological stress and improve emotional states.

4.3. Value and unique advantages of the integrated traditional Chinese and Western medicine model

The acupressure antithrombotic pump in this study successfully demonstrates the effective integration of Western medical equipment treatment with traditional Chinese medicine external therapies. Its core advantages lie in the following:

4.3.1. Synergistic enhancement

Western antithrombotic pump treatment improves hemodynamics through physical external force, directly reducing venous stasis and serving as a classic mechanical means for preventing deep vein thrombosis (DVT). Traditional Chinese medicine acupoint stimulation, based on a holistic perspective, activates meridians and harmonizes Qi, blood, Yin, and Yang, thereby regulating the neuro-endocrine-immune network and vascular endothelial function, and improving the internal environment of "hypercoagulability" at a deeper level [10]. The effective combination of these two approaches achieves simultaneous treatment of both the "symptoms" and the "root cause", with physical external force and biological effects working synergistically to achieve superior results in improving coagulation indicators compared to single approaches or simple additive effects.

4.3.2 Safety and generalizability

Compared to pharmacological anticoagulation therapy, acupoint pressure antithrombotic pump therapy is a non-invasive physical therapy with minimal side effects. Moreover, its standardized operation and controllable parameters avoid issues such as uneven pressure and time- and labor-consuming processes that may arise with manual massage. No adverse events related to the device were observed during the study's observation period, indicating good safety. In addition to being suitable for

colorectal cancer surgery patients requiring multimodal thrombosis prevention, this device should also hold high utility value for other tumor and surgical patient populations, making it easy to promote in clinical settings.

4.3.3. Comprehensive multi-target intervention to promote accelerated overall recovery of patients

This device primarily focuses on DVT prevention, while its acupoint stimulation also plays a significant positive role in pain management, gastrointestinal function recovery, and psychological adjustment, meeting the comprehensive physiological-psychological-social needs of patients under the current ERAS concept [11]. This characteristic of "one method with multiple effects" is difficult to match by purely Western medical devices or medications, highlighting the value of integrated traditional Chinese and Western medicine nursing in enhancing overall care efficacy.

4.4. Study limitations and future directions

This study is single-center research with a relatively limited sample size, which may introduce certain selection bias and affect the generalizability of the results. Secondly, the observation period was primarily focused on the postoperative hospitalization period, lacking long-term follow-up assessment of deep vein thrombosis (DVT). Furthermore, this study did not delve into the effects of different pressure parameters, stimulation durations, and varying intensities of acupoint effects, leaving room for optimizing treatment protocols. Future research can further validate these findings by expanding the sample size, conducting multi-center randomized controlled trials (RCTs), assessing long-term effects through follow-up, and optimizing acupoint stimulation protocols.

This study confirms that the acupoint pressure antithrombotic pump, which integrates traditional Chinese medicine meridian acupoint theory with modern mechanical antithrombotic technology, can effectively prevent the occurrence of DVT in patients undergoing colorectal cancer surgery and significantly improve their quality of life across multiple dimensions. The technology, which combines this device with auxiliary devices, is easy to operate, safe, and synergistic in multiple effects, providing a promising innovative strategy for preventing postoperative DVT and promoting comprehensive and accelerated rehabilitation in patients, thus holding significant value for clinical application and dissemination.

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Disclosure statement

The authors declare no conflict of interest.

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