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ABOUT COVER

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ORIGINAL ARTICLE

Randomized Controlled Trial

Effects of fluid therapy combined with a preoperative glucose load regimen on postoperative recovery in patients with rectal cancer

Lv-Chi Xia, Ke Zhang, Chuan-Wen Wang

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Abstract

BACKGROUND

Patients with rectal cancer undergoing radical resection often have poor post-operative recovery due to preoperative fasting and water deprivation and the removal of diseased tissue, and have a high risk of complications. Therefore, it is of great significance to apply appropriate rehydration regimens to patients undergoing radical resection of rectal cancer during the perioperative period to improve the postoperative outcomes of patients.

AIM

To analyze the effects of goal-directed fluid therapy (GDFT) with a preoperative glucose load regimen on postoperative recovery and complications in patients undergoing radical resection for rectal cancer.

METHODS

Patients with rectal cancer who underwent radical resection (n = 184) between January 2021 and December 2023 at our hospital were randomly divided into either a control group or an observation group (n = 92 in each group). Both groups received a preoperative glucose load regimen, and routine fluid replacement and GDFT were additionally implements in the control and observation groups, respectively. The operative conditions, blood levels of lactic acid and inflammatory markers, postoperative recovery, cognitive status, hemodynamic indicators, brain oxygen metabolism, and complication rates were compared between the groups.

RESULTS

The colloidal fluid dosage, total infusion, and urine volume, as well as time to first exhaust, time to food intake, and postoperative length of hospital stay, were lower in the observation group (P < 0.05). No significant differences were observed between the two groups in terms of operation time, bleeding volume, crystalloid liquid consumption, time to tracheal extubation, complication rate, heart rate, or mean arterial pressure (P > 0.05). Compared with the control group, in the observation group the lactic acid level was lower immediately after the surgery (P < 0.05); the Mini-Mental State Examination score was higher on postoperative day 3 (P < 0.05); the pulse pressure variability (PPV) was lower at 30 min after pneumoperitoneum (P < 0.05), though the differences in the PPV of the two groups was not significant at the remaining time points (P > 0.05); tumor necrosis factor-α and interleukin-6 levels were lower on postoperative day 3 (P < 0.05); and the left and right regional cerebral oxygen saturation was higher immediately after the surgery and 30 min after pneumoperitoneum (P < 0.05).

CONCLUSION

GDFT combined with the preoperative glucose load regimen is a safe and effective treatment strategy for improving postoperative recovery and risk of complications in patients with rectal cancer undergoing radical resection.

Key Words: Radical resection of rectal cancer; Goal-directed fluid therapy; Preoperative glucose load; Cognitive condition; Complication

Core Tip: The application of goal-directed fluid therapy combined with a preoperative glucose load regimen in patients with rectal cancer undergoing radical resection can not only significantly improve the postoperative recovery and brain tissue oxygen metabolism, but also alleviate inflammatory reactions, and improve cognitive function, hemodynamics, and blood lactate levels. This study observed the postoperative recovery of patients undergoing radical resection for rectal cancer, and confirmed the effectiveness of goal-directed fluid therapy combined with a preoperative glucose load regimen in patients undergoing radical resection for rectal cancer.

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INTRODUCTION

The incidence of rectal cancer, a primary malignant tumor involving the rectal mucosal epithelium, has been frequently reported in 40-80-year-old men. Rectal cancer does not present with any obvious symptoms during the early stage; however, tumor metastasis, accompanied by jaundice, dyspnea, dizziness, headache, and pain at the site of bone metastasis, may occur with the progression of the disease. This may endanger the well-being of the patient[1,2]. Radical resection of rectal cancer, which involves the excision of the diseased tissue, remains the first-line treatment for rectal cancer. Anesthetic interventions play a crucial role in ensuring the smooth progression of the radical resection of rectal cancer. However, the administration of anesthetic agents can induce adverse reactions, such as hypotension, and relatively evident hemodynamic fluctuations intraoperatively, which affect the safety outcomes[3,4]. Patients are instructed to fast before radical resection of rectal cancer. Deprivation of food and water for a long duration can induce water and electrolyte disorders in patients. Preoperative glucose load regimen involves the oral administration of carbohydrates 2 h before the surgery to alleviate thirst and hunger in patients. This regimen has been implemented in patients with rectal cancer undergoing radical resection; however, its effects on conditions such as hypotension and hemodynamic fluctuation caused by anesthesia are minimal[5,6].

Goal-directed fluid therapy (GDFT) facilitates the monitoring of the hemodynamic status of patients in real time. The fluid replacement method is adjusted according to the detected conditions to maintain the hemodynamic stability and improve the tissue supply. Few studies have investigated the effects of GDFT combined with a preoperative glucose load regimen on postoperative recovery in patients with rectal cancer undergoing radical resection. Based on these results, patients with rectal cancer undergoing radical resection (n = 184) were included in this study to evaluate the effects of GDFT combined with a preoperative glucose load regimen on their postoperative recovery.

MATERIALS AND METHODS

Patients

Patients with rectal cancer who underwent radical resection (n = 184) at our hospital between January 2021 and December 2023 were randomly divided into either a control group or an observation group (n = 92 cases in each group). The inclusion criteria were as follows: Patients who met the diagnostic criteria for rectal cancer outlined in the Chinese Protocol of Diagnosis and Treatment of Colorectal Cancer (2023 edition)[7], patients with American Society of Anesthesiologists

(ASA) grades II and III, and patients with normal cognitive function before the surgery. The exclusion criteria were as follows: Use of antidepressants, sedatives, or other drugs within 1 mo before the surgery; history of abdominal surgery; and risk of reflux aspiration. The control group comprised 62 men and 30 women. The mean age of the patients was 58.44 ± 10.25 years (range, 41-75 years). The ASA grades were II and III in 58 and 34 patients, respectively. The average body mass index (BMI) was 22.47 ± 2.03 kg/m^2 (range, 20-25 kg/m^2). The observation group comprised 63 men and 29 women. The mean age of the patients was 58.37 ± 10.15 years (range, 40-75 years). The ASA grades were II and III in 59 and 33 patients, respectively. The average BMI was 22.42 ± 2.04 kg/m^2 (range, 20-25 kg/m^2). No significant differences were observed between the groups in terms of clinical data such as age or sex (P > 0.05).

Methods

A preoperative glucose load regimen was implemented in both groups. The patients in both groups fasted for 8 h before the surgery. Water deprivation was implemented for 6 h before the surgery. Oral carbohydrates (4 mL/kg; 10% glucose) were administered orally 2 h before the surgery, and the total volume was < 300 mL.

Midazolam (0.05 mg/kg; intravenous administration) was administered after the patient entered the operating room. Routine monitoring of blood pressure and electrocardiography were commenced after inducing local anesthesia. A catheter was inserted into the artery to monitor the mean arterial pressure (MAP) and pulse pressure variability (PPV).

For anesthesia induction, etomidate (0.3 mg/kf), sufentanil (0.3-0.4 μg/kg), and rocuronium (0.6 mg/kg) were administered intravenously. Tracheal intubation and mechanical ventilation were performed subsequently. The respiratory frequency, tidal volume, and end-tidal carbon dioxide were maintained at 10-12 times/min, 8-9 mL/kg, and 35-45 mmHg, respectively. Continuous infusion of remifentanil and propofol was maintained intraoperatively to ensure that the bispectral index was maintained between 40 and 60. Pentoxifylline (5 mg), ondansetron (4 mg), dexamethasone (5 mg), and 0.5% ropivacaine were administered before the end of the surgery to facilitate wound healing.

Sodium lactate solution (3 mL/kg/h) was administered intravenously to all participants. Ephedrine (6 mg) was administered intravenously during the surgery if the MAP was < 60 mmHg for > 15 min. The crystalloid solution used was a mixture of sodium lactate Ringer's solution and a colloid mixed at a 3:1 ratio.

Routine fluid replacement and traditional infusion were implemented in the control group. Norepinephrine (0.03 μg/kg/min) was infused intravenously if the systolic blood pressure had a decrease of > 20% compared with the preoperative value after the continuous administration of ephedrine. The dose of norepinephrine was adjusted according to the systolic blood pressure. Red blood cells were transfused if the hemoglobin level was < 100 g/L intraoperatively.

GDFT and the monitoring of PPV and systolic blood pressure were implemented in the observation group. Fluid replacement (3 mL/kg) was performed for 5 min when the systolic blood pressure increased by > 20% or the PPV reached or exceeded 13% of the preoperative values. The patients were re-evaluated subsequently. Fluid replacement was discontinued when the systolic blood pressure returned to the normal range or the PPV was < 13%; only real-time monitoring was performed. Fluid replacement was performed at 3 mL/kg for less than 5 min when the systolic blood pressure was < 20% and the PPV was > 13% of the preoperative values. Norepinephrine (0.03 μg/kg/min) was infused intravenously when the PPV was < 13% and > 10 mL/kg. The dose of norepinephrine was adjusted according to the systolic blood pressure.

Outcome indicators

Operative conditions: The operation time and urine volume in the two groups were recorded.

Blood lactic acid levels: Peripheral venous blood samples were collected immediately after entering the operating room and immediately after the surgery. Blood lactic acid levels were detected using ultraviolet spectrophotometry.

Postoperative recovery: Time to first exhaust time, time to tracheal extubation, time to food intak, and postoperative length of hospital stay in the two groups were recorded.

Cognitive status: The patients were evaluated using the Mini-Mental State Examination (MMSE) before and 3 d after the surgery. The MMSE comprises 30 items, with a total score ranging from 0 to 30 points. MMSE scores of 27-30, 21-26, 10-20, and 0-9 points indicated normal state, mild cognitive impairment, moderate cognitive impairment, and severe cognitive impairment, respectively.

Hemodynamic indicators: The heart rate (HR), MAP, and PPV were recorded 1 d before the surgery (T0), before the induction of anesthesia (T1), immediately after the surgery (T2), 30 min after pneumoperitoneum (T3), and immediately after the surgery (T4).

Inflammatory factors: Venous blood samples were collected before and 3 d after the surgery in the fasting state. TNF-α and IL-6 levels were measured by ELISA.

Oxygen metabolism in brain tissue: Left and right regional cerebral oxygen saturation ($rScO_2$) was measured using a brain oxygen saturation monitor at T1, T2, and T3.

Complications: The incidence of complications, such as nausea, vomiting, wound infection, pulmonary infection, and urinary system infection, was recorded.

Statistical analysis

All statistical analyses were performed using SPSS 22.0. Measurement data were tested for normality by the Shapiro-Wilk test. Count data are presented as *n* (%), and inter-group comparisons were performed using the χ^2 test or the corrected χ^2 test when *n* was > 30 or < 5. Measurement data are presented as the mean ± SD, and inter-group comparisons were performed using the *t* test. Statistical significance was set at $P < 0.05$.

RESULTS

Comparison of operative conditions

The colloid fluid dosage, total infusion volume, and urine volume were lower in the observation group ($P < 0.05$). In contrast, the operation time, intraoperative bleeding volume, and crystalloid liquid dosage did not differ significantly between the two groups ($P > 0.05$; Table 1).

Comparison of blood lactic acid levels

No significant differences were observed between the two groups in terms of blood lactic acid levels measured immediately after entering the operating room ($P > 0.05$). However, blood lactic acid level was lower immediately after the surgery in the observation group than in the control group ($P < 0.05$; Table 2).

Comparison of postoperative recovery

The time to first exhaust, time to food intake, and postoperative length of hospital stay were shorter in the observation group ($P < 0.05$), though no significant difference was observed in the time to tracheal extubation between the two groups ($P > 0.05$; Table 3).

Comparison of cognitive status

No significant differences were observed between the groups in terms of the MMSE scores before the surgery ($P > 0.05$). The MMSE score on postoperative day 3 was higher in the observation group than in the control group ($P < 0.05$; Table 4).

Comparison of hemodynamic indicators

No significant differences were observed between the groups at any time point in terms of HR and MAP ($P > 0.05$). PPV at T3 in the observation group was significantly lower that of the control group ($P < 0.05$). However, PPV did not differ significantly in the two groups at T0, T1, T2, and T4 ($P > 0.05$; Table 5).

Comparison of inflammatory factor levels

No significant differences were observed between the groups in terms of the inflammatory factor levels before the surgery ($P > 0.05$). TNF-α and IL-6 levels on postoperative day 3 were lower in the observation group than in the control group ($P < 0.05$; Table 6).

Comparison of oxygen metabolism in brain tissue

No significant differences were observed between the two groups in terms of brain tissue oxygen metabolism indices at T1 ($P > 0.05$). The $rScO_2$ levels on the left and right sides at T2 and T3 were significantly higher in the observation group than in the control group ($P < 0.05$; Table 7).

Comparison of complications

No significant differences were observed between the groups in terms of the incidence of complications ($P > 0.05$; Table 8).

DISCUSSION

The etiology of rectal cancer is relatively complex and is often the result of a combination of environmental, diet, lifestyle, and genetic factors. Radical resection remains the treatment of choice for rectal cancer. Resection involves the complete excision of the tumor and part of the surrounding tissues during surgery; it is mainly used for the treatment of early- and middle-stage rectal cancer. Surgical technology has advanced with the developments in the field of medical technology. This has led to a reduction in morbidity. Nevertheless, blood loss and body fluid loss occur during surgery. Thus, maintaining the body fluid balance intraoperatively is necessary. Fasting and water deprivation are often implemented before radical resection of rectal cancer. In addition to causing disorders of glucose metabolism and imbalance of homeostasis postoperatively, long-term fasting and water deprivation may lead to collapse or shock[8-10]. Preoperative glucose load regimen involves instructing patients to consume oral carbohydrates to supplement body fluids and energy before the surgery. This helps maintain the ability of various organs and tissues of the body and avoid the occurrence of shock[11,12]. Implementation of a preoperative glucose load regimen will facilitate the maintenance of blood glucose balance and reduce the risk of developing serious complications. Thus, a preoperative glucose load regimen helps maintain the physiological balance in patients with rectal cancer undergoing radical resection and reduces the risk of complications. However, more effective intervention methods must be developed, considering the poor efficacy of this regimen in maintaining hemodynamic stability, reducing intraoperative blood loss, and preventing fluid loss.

Table 1 Comparison of operative conditions, mean ± SD

Group	Number of cases	Operation time (minute)	Intraoperative bleeding volume (mL)	Crystalloid liquid (mL)	Colloid fluid (mL)	Total infusion volume (mL)	Urine volume (mL)
Observation group	92	183.61 ± 8.52	249.25 ± 10.22	1134.69 ± 20.98	521.06 ± 10.52	1908.25 ± 20.66	321.58 ± 10.52
Control group	92	183.67 ± 8.55	248.63 ± 10.36	1129.87 ± 20.55	532.05 ± 10.56	1915.58 ± 20.32	522.14 ± 10.777
t value		0.048	0.409	1.574	7.072	2.426	127.733
P value		0.962	0.683	0.117	< 0.001	0.016	< 0.001

Table 2 Comparison of blood lactic acid levels, mean ± SD

Group	Number of cases	Blood lactic acid level (mmol/L)	
		Immediately after entering operating room	Immediately after surgery
Observation group	92	1.09 ± 0.22	1.24 ± 0.24
Control group	92	1.10 ± 0.25	1.38 ± 0.29
t value		0.288	3.567
P value		0.774	< 0.001

Table 3 Comparison of postoperative recovery, mean ± SD

Group	Number of cases	Time to first exhaust (h)	Time to tracheal extubation (h)	Time to food intake (h)	Postoperative hospital stay (d)
Observation group	92	72.63 ± 6.88	0.66 ± 0.16	67.58 ± 4.28	11.14 ± 1.22
Control group	92	90.51 ± 6.40	0.69 ± 0.17	77.25 ± 4.63	14.78 ± 1.40
t value		18.251	1.233	14.710	18.801
P value		< 0.001	0.219	< 0.001	< 0.001

Table 4 Comparison of cognitive condition (mean ± SD, points)

Group	Number of cases	Mini-Mental State Examination score	
		Preoperatively	3 d after surgery
Observation group	92	27.42 ± 1.05	26.77 ± 1.15
Control group	92	27.33 ± 1.11	25.01 ± 1.25
t value		0.565	9.939
P value		0.573	< 0.001

The colloid fluid dose, total infusion volume, and urine volume, as well as time to first exhaust, time to food intake, and postoperative length of hospital stay were lower in the observation group than in the present study (P < 0.05). This finding indicates that implementing GDFT combined with a preoperative glucose load regimen improved the surgical outcome of radical resection and postoperative recovery. GDFT facilitates the improvement of cardiac output, tissue and organ perfusion, and oxygen supply by enabling the monitoring of the changes in body volume in real time and guiding fluid replacement according to the condition of the patients[13,14]. The fluid infusion measures implemented as a part of GDFT address the phenomenon of insufficient circulation volume during the surgery, maintain tissue perfusion, and reduce the incidence of adverse effects (such as intraoperative blood loss and body fluid loss).

Blood lactic acid levels reflect the intraoperative oxygen supply and consumption. Patients with rectal cancer undergoing radical resection may experience intraoperative hypotension and hypothermia, which may cause an increase in blood lactic acid levels. The lactic acid levels were lower in the observation group than in the control group immediately after the surgery (P < 0.05), indicating that implementing GDFT combined with the preoperative glucose load regimen could improve these levels in patients with rectal cancer undergoing radical resection. Implementing the preoperative

Table 5 Comparison of hemodynamic indicators, mean ± SD

Group	Number of cases	HR (times/min)					Mean arterial pressure (mmHg)					Pulse pressure variability (%)				
		T0	T1	T2	T3	T4	T0	T1	T2	T3	T4	T0	T1	T2	T3	T4
Observation group	92	66.41 ± 4.55	67.25 ± 5.66	68.69 ± 4.60	68.99 ± 4.05	70.11 ± 4.05	76.02 ± 4.05	78.10 ± 6.25	80.01 ± 6.11	81.98 ± 6.40	83.99 ± 6.24	-	11.75 ± 1.02	9.87 ± 0.98	12.79 ± 1.13	8.82 ± 0.76
Control group	92	66.78 ± 4.25	67.05 ± 5.14	68.25 ± 4.05	68.11 ± 4.14	70.25 ± 4.22	76.27 ± 5.60	77.89 ± 6.11	80.25 ± 6.45	82.66 ± 6.52	84.14 ± 6.66	-	12.01 ± 1.25	9.89 ± 0.94	14.96 ± 1.35	9.02 ± 0.77
t value		0.570	0.251	0.689	1.457	0.230	0.347	0.230	0.259	0.714	0.158		1.546	0.141	11.823	1.773
P value		0.569	0.802	0.492	0.147	0.819	0.729	0.818	0.796	0.476	0.875		0.124	0.888	< 0.001	0.078

glucose load regimen can reduce the risk of intraoperative hypotension and improve lactic acid levels by supplementing energy sources before the surgery. In contrast, GDFT reduces intraoperative blood loss and inhibits the effect of body fluids on body temperature by facilitating the monitoring of the patient's condition in real time, implementation of liquid supplement measures at any time point, and further improving the lactic acid levels in combination with the preoperative glucose load regimen[15,16].

The MMSE score was higher in the observation group than in the control group 3 d after the surgery in the present study ($P < 0.05$), suggesting that the implementation of GDFT combined with the preoperative glucose load regimen could improve the postoperative cognitive status of patients with rectal cancer undergoing radical resection. GDFT facilitates the monitoring of the changes in PPV, systolic blood pressure, and other indicators in patients with rectal cancer undergoing surgery, thereby enabling intraoperative fluid replacement. This enables the optimization of the perioperative hemodynamics of patients and reduction of the risk of developing abnormal blood volume during the perioperative period, thereby improving the postoperative recovery. GDFT helps increase the oxygen supply in brain tissue, reduce the impact of oxygen supply shortage in brain tissue on the cognitive function, and improve the cognitive status of patients after the surgery by facilitating the monitoring of the changes in the relevant indicators in real time and adjustment of the fluid replacement scheme during the operation.

Owing to the effect of factors such as fluid loss and hypothermia, patients undergoing radical resection for rectal cancer have abnormal hemodynamics, leading to changes in the levels of relevant hemodynamic indicators. The data in this study showed that PPV was lower in the observation group at T3 ($P < 0.05$). This finding indicates that the implementation of GDFT combined with the preoperative glucose load regimen could improve the hemodynamic profiles of patients with rectal cancer undergoing radical resection. PPV is a commonly used hemodynamic indicator that reflects the capacity of the body. The changes in PPV were observed in the present study to commence fluid supplementation to relieve the loss of body fluids. Fluid supplementation will improve the PPV, thereby maintaining hemodynamic stability. No significant differences were observed between the two groups in terms of HR and MAP at any time point ($P > 0.05$; Table 5). This finding indicates that the implementation of GDFT combined with the preoperative glucose load regimen had a relatively small effect on HR and MAP in patients with rectal cancer undergoing radical resection.

IL-6 is a common indicator of acute inflammation. TNF-α can mediate the production of other inflammatory factors in the body and aggravate the inflammatory response. Owing to the effect of factors such as hypotension, intraoperative fluid loss, and insufficient energy, patients with rectal cancer undergoing radical resection are prone to developing stress responses and inflammatory reactions. The TNF-α and IL-6 Levels were lower in the observation group 3 d after the surgery ($P < 0.05$; Table 6). This finding indicates that the implementation of GDFT combined with the preoperative glucose load regimen could improve the inflammatory status of patients with rectal cancer undergoing radical resection.

Table 6 Comparison of inflammatory factor levels, mean ± SD

Group	Number of cases	TNF-α (mg/L)		IL-6 (ng/L)	
		Preoperatively	3 d after surgery	Preoperative	3 d after surgery
Observation group	92	60.14 ± 4.03	32.53 ± 3.06	80.25 ± 8.79	41.26 ± 4.03
Control group	92	60.22 ± 4.14	38.77 ± 3.14	80.36 ± 8.41	52.06 ± 4.19
t value		0.133	13.651	0.087	17.819
P value		0.894	< 0.001	0.931	< 0.001

Table 7 Comparison of oxygen metabolism in brain tissue, mean ± SD

Group	Number of cases	Left $rScO_2$ (%)			Right $rScO_2$ (%)		
		T1	T2	T3	T1	T2	T3
Observation group	92	72.05 ± 6.25	68.41 ± 5.05	66.10 ± 6.31	70.22 ± 6.37	67.08 ± 5.40	65.11 ± 4.06
Control group	92	72.11 ± 6.45	64.25 ± 5.11	62.08 ± 6.16	70.40 ± 6.49	64.99 ± 5.19	61.78 ± 4.27
t value		0.064	5.554	4.373	0.190	2.677	5.421
P value		0.949	< 0.001	< 0.001	0.850	0.008	< 0.001

Table 8 Comparison of incidence of complications, *n* (%)

Group	Number of cases	Nausea and vomiting	Wound infection	Pulmonary infection	Urinary system infection	Total incidence
Observation group	92	1 (1.09)	1 (1.09)	0	0	2 (2.17)
Control group	92	2 (2.17)	3 (3.26)	0	0	5 (5.43)
χ^2						0.594
P value						0.441

The preoperative glucose load regimen instructs patients to consume oral carbohydrates before surgery to supplement body fluid and energy and reduce the impact of body fluid loss and insufficient capacity on the inflammatory response. In contrast, GDFT enables the monitoring of the changes in PPV and systolic blood pressure in patients in real time and supplementation of body fluids, thereby improving cardiac function. In addition, it can achieve fluid replacement rapidly, improve the oxygen supply, and reduce the risk of hypotension. Combined with the preoperative glucose load regimen, GDFT further alleviated the inflammatory state of the patients.

Clinical research has shown that hypoxia in brain tissue is characterized by poor tolerance and high metabolism. The oxygen demand status of brain tissue can reflect brain injury and metabolism and can be used to assess the oxygen supply balance of brain tissue by observing changes in $rScO_2$ levels[17]. Radical resection of rectal cancer causes damage to the body and stress reactions, resulting in increased brain oxygen consumption and functional brain metabolism abnormalities. Therefore, the $rScO_2$ Levels declined to a certain extent at the beginning of surgery. However, the rScO2 Levels on the left and right sides were higher in the observation group than in the control group at T2 and T3 ($P < 0.05$; Table 7). GDFT facilitates the adjustment of the fluid replacement method at any time by enabling the monitoring of PPV. Fluid replacement can also reduce the probability of excessive fluid replacement and the load of excessive fluid replacement on the heart of the body by meeting the needs of the body. This promotes the improvement of patients' capacity and cardiac output and ensures oxygen supply to brain tissue. In combination with the preoperative glucose load regimen, it improves the brain oxygen metabolism in patients.

This study found no significant differences between the two groups in terms of the incidence of complications ($P > 0.05$). This finding indicates that the implementation of GDFT combined with the preoperative glucose load regimen had a relatively small effect on the risk of complications in patients with rectal cancer undergoing radical resection; moreover, its safety was high. However, due to the limited sample size of this study, the results may be biased. In the future, we need to expand the sample size and conduct multi-center cooperative research to obtain more robust and generalizable evidence.

CONCLUSION

The implementation of GDFT combined with a preoperative glucose load regimen in patients with rectal cancer undergoing radical resection can significantly improve postoperative recovery and cognitive status, alleviate the inflammatory response, and improve hemodynamic cerebral oxygen metabolism. Thus, it is an ideal preoperative intervention and intraoperative fluid replacement method for patients with rectal cancer undergoing radical resection.

FOOTNOTES

Author contributions: Xia LC designed the research study; Xia LC, Zhang K, and Wang CW performed the primary literature and data extraction; Xia LC, Zhang K, and Wang CW analyzed the data and wrote the manuscript; Xia LC was responsible for revising the manuscript for important intellectual content; all authors read and approved the final version.

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