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Observations on the effect of Danshen on gastrointestinal function and nutritional proteins after laparoscopic surgery

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Abstract: Recurrent vomiting and sleep disturbance are typical postoperative complications of laparoscopic surgery, how to improve the postoperative gastrointestinal function of patients undergoing laparoscopic surgery is one of the key links to ensure their recovery. In this study, we looked at the effect of danshen acupressure on the postoperative recovery of patients undergoing laparoscopic surgery. For this purpose, we included 105 study subjects, all patients received information-motivation-behavioral skills (IMB) model-based care, of which 51 patients did not receive danshen treatment and were considered as a control group, another 54 patients were treated with danshen and considered as the research group. Comparison of gastrointestinal function between the two groups and nutritional status, psychological status, etc., we found that the gastrointestinal function of the research group recovered better and gastrin (GAS) and motilin (MTL) were lower than those of the control group ($P<0.05$). Meanwhile, the psychological status of the research group was also better than that of the control group and the level of nutritional protein was higher than that of the control group ($P<0.05$). Through the prognostic follow-up, we also found a better prognostic quality of life in the research group.

Keywords: Danshen, information-motivation-behavioral skills model, laparoscopic surgery, nutritional status, recurrent vomiting, sleep disturbances

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INTRODUCTION

Over the past 2 decades, laparoscopic surgery (LS) has been a widely used minimally invasive surgical approach that utilizes modern high-tech medical technology to complete the surgery by inserting a camera lens and surgical instruments into the body (Chuang & Chuang, 2022). Compared to traditional open surgery, it has the advantages of less trauma, fewer complications and faster recovery, which greatly increases the chances of surgical selection (Vilos *et al.*, 2021). However, due to the need for intestinal preparation work such as residue-free semi-liquid diet or fasting and water deprivation before LS, as well as multiple factors during and after surgery, patients are prone to gastrointestinal dysfunction, with most of them experiencing postoperative adverse symptoms such as delayed anal exhaust, abdominal pain and bloating and nausea and vomiting, among which repeated vomiting and sleep disturbances is the representative complication (Saeidi *et al.*, 2022). These complications can seriously affect patients' postoperative recovery, increase the risk of postoperative complications and ultimately lead to a poor prognosis (Fu *et al.*, 2022). Meanwhile, the balance of the gastrointestinal tract, the most important site for human nutrition absorption and metabolism, will be greatly disrupted by LS, compromising the nutritional status of patients and reducing the body's healthy functioning (Romeo *et al.*, 2021). Therefore, providing more reliable postoperative gastrointestinal function safety assurance for LS patients is of great significance for their prognosis and health.

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Traditional Chinese medicine (TCM) has a unique effect on ameliorating gastrointestinal dysfunction. Acupoint application can promote gastrointestinal peristalsis, improve patients' nutrient absorption and promote rehabilitation by applying plaster patches that improve gastrointestinal function to acupoints related to the gastrointestinal tract (Zheng *et al.*, 2022). Danshen, danshen is the dried root and rhizome of Salvia miltiorrhiza Bge. in the family Labiatae and its main chemical constituents are crystalline phenanthrenequinones, is commonly used in TCM as an adjuvant treatment to promote blood circulation and eliminate blood stasis, with its effects on the improvement of gastrointestinal diseases repeatedly verified (Liu *et al.*, 2016; Jing *et al.*, 2023). However, there are no studies confirming the effects of danshen in patients with recurrent vomiting and sleep disorders after LS. Meanwhile, in TCM, danshen usually needs to be combined with other medications for combination therapy and few studies have been reported on the use of danshen alone.

Based on this, this study will carry out a detailed study on the improvement of the nutritional status of patients with post-LS repeated vomiting and sleep disturbances by danshen, so as to provide a credible clinical reference.

MATERIALS AND METHODS

Selection of research subjects

The sample size needed for this study was calculated through G*Power software by setting effect size=0.2, which showed that a minimum of 96 subjects (48 per group) were needed for this study. Subsequently, we

conducted a retrospective analysis of the research subjects were 105 patients who underwent LS in The Second Affiliated Hospital of the Naval Medical University from March 2021 to March 2023, all patients received information-motivation-behavioral skills (IMB) model-based care, of which 51 patients did not receive danshen treatment (because they were allergic to danshen or refused danshen) and were considered as a control group, with 28 males and 23 females, age (38.47±4.76) years, Body mass index (23.80±1.78) kg/m^2, colorectal cancer 18 cases, gastric cancer 16 cases, ovarian cancer 8 cases, uterine fibroid 8 cases, other 1 cases. Another 54 patients were treated with danshen and considered as the research group, 31 males and 23 females, age (38.13±4.88) years, BMI (23.65±1.80) kg/m^2, colorectal cancer 18 cases, gastric cancer 19 cases, ovarian cancer 10 cases, uterine fibroid 5 cases, other 2 cases. The participants and their families were informed of the study and signed the informed consent form. The study has been approved by the Ethics Committee of The Second Affiliated Hospital of the Naval Medical University (No.2021kl042). fig. 1 illustrates the flow of this study.

Eligibility and exclusion criteria

Inclusion criteria: The subjects were gynecological or surgical patients (>20 years old) who were diagnosed by the attending physician of our hospital to need LS, with normal routine examination results before surgery, normal communication skills, good compliance, no contraindications for anesthesia, surgery, or medication, no preoperative gastrointestinal dysfunction and no mental illness. Exclusion criteria: Preoperative use of antiemetic medication; history of multiple surgeries; presence of hematoma, damage, or infection on the skin at the acupoint application site; conversion to open surgery; pregnant or lactating women; incomplete case data.

METHODS

The nursing staff understood patients' awareness of disease-related knowledge, corrected their wrong cognition in time, guided the precautions in diet and life with a combination of oral education and video preaching and provided correct medication information one-on-one. (2) Change patients' behavioral motivation, that is, to encourage patients to improve their confidence in treatment by sharing the experiences of patients with good prognoses in the past. (3) Ensure the implementation of patients' healthy behaviors, such as reasonable diet, healthy lifestyles and standardized medication, which were investigated through regular follow-ups. On this basis, the research group gave danshen treatment: depending on the patient's surgical methods, bilateral Zusanli, Neiguan, Tianshu, Zhongwan and Shenque acupoints were selected as the application points for application therapy 30 minutes after the operation. The ointment was applied to the relevant acupoints and replaced every 6 hours until the patient had anus exhaust. Preparation of danshen ointment: take 30g of danshen and add 500mL of water to the decoction. Boil over high heat and turn to low heat to decoct and turn off the heat when it is concentrated to about 50mL. Put the gauze into the concentrated solution soaked thoroughly for 30min and then take it out to apply the patch.

Prognostic follow-up

We conducted a 1-year prognostic follow-up (in the form of regular reviews at intervals of no more than 3 months) for all study participants. At the last follow-up, we used the Generic Quality of Life Inventory-74 (GQOLI-74) (Zheng *et al.*, 2019) from four dimensions: material life state, physical function, social function and psychological function. The score is positively associated with the quality of life.

Endpoints

(1) Gastrointestinal function: The time of bowel sound recovery, anal exhaust, bowel movement and return to normal diet, as well as the incidence of repeated vomiting and sleep disturbances, were counted in both groups. In addition, fasting venous blood was drawn before and after nursing to detect gastrin (GAS) and motilin (MTL). (2) Psychological status: Both groups were assessed by the Self-Rating Anxiety Scale (SAS) and Self-Rating Depression Scale (SDS) (Yue *et al.*, 2020) for changes in their psychological status before and after intervention (lower score means less anxiety and depression). Besides, the Pittsburgh sleep quality index (PSQI) (Zitser *et al.*, 2022) was used for postoperative pain assessment. (3) Nutritional status: Albumin (ALB), hemoglobin (Hb), total protein (TP) and transferrin (TRF) were detected before and after nursing. (4) Safety: The incidence of complications during the nursing process was counted. (5) Prognosis: including patients' prognostic survival and GQOLI-74 score results.

STATISTICAL ANALYSIS

SPSS 23.0 statistical software is used to perform statistical analysis on the data results. Quantitative data were expressed by ($\bar{\chi}$±s) and comparisons were made with independent sample t-tests and t-tests. Qualitative data was represented by [n(%)] and comparisons were made by $\chi 2$ tests. $P<0.05$. Survival rates were calculated using the Kaplan-Meier method and comparisons of survival rates were performed using the log-rank test. A $P<0.05$ is considered statistically significant.

RESULTS

The gastrointestinal function in the research group recovered faster

The statistical results showed that the research group had a shorter recovery time for postoperative bowel sounds, first

anal exhaust and first bowel movement compared to the control group (P<0.05). In addition, the incidence of postoperative repeated vomiting and sleep disturbances in the research group was 7.41%, which was also lower compared with the control group (P<0.05, table 1).

The gastrointestinal mucosal function was better in research group than in control group

The comparison of GAS and MTL before nursing showed no significant difference between groups (P>0.05). After nursing, the GAS and MTL in the research group decreased to (62.38±6.03) pg/mL and (226.28±26.57) pg/mL, respectively, both of which were lower compared with the control group (P<0.05, fig. 2).

The psychological status was better in the research group versus the control group

The two groups showed similar scores of PSQI, SAS and SDS before nursing (P>0.05). After nursing, PSQI, SAS and SDS in the research group were (8.43±1.89), (17.19±3.31) and (14.20±3.47), respectively, which were all lower compared to the before nursing and were more lower than those in the control group (P<0.05, fig. 3).

The research group had higher nutrition-associated protein levels than the control group

No significant inter-group difference was found in nutrition-associated protein detection results before nursing (P>0.05). After nursing, ALB, HGB, TRF and TP did not change in the control group (P>0.05); ALB, HGB, TRF and TP were elevated to (36.16±4.81), (124.99±16.06), (40.09±3.16) and (2.37±0.72) in the research group and were more higher than those in the control group (P<0.05, fig. 4).

The treatment used in the research group was safer

The statistical results showed that the incidence of complications in the research group was 5.56%, which was lower than that of the control group (P<0.05, table 2).

The research group had a better prognostic life situation than the control group

Prognostic follow-up was successfully tracked for all study subjects and the difference in prognostic overall survival rates between the two groups was not statistically significant (P>0.05), however, the GQOLI-74 score showed that the material life state, physical function, social function and psychological function scores of the research group were (65.39±8.30), (63.31±6.64), (65.13±8.08), (65.37±10.96), which were significantly higher compared to the control group (P<0.05, fig. 5).

DISCUSSION

The development and improvement of minimally invasive techniques have led to the increasing application rate of LS in clinical practice. However, invasive mechanical manipulation cannot avoid causing certain stress damage to patients, with repeated vomiting and sleep disturbances being one of the typical postoperative complications (Nakanishi *et al.*, 2022). Reducing the incidence of repeated vomiting and sleep disturbances after LS is one of the keys to improving surgical safety, as well as the focus of modern clinical research. Currently, studies have defined repeated vomiting and sleep disturbances as key factors affecting postoperative recovery from LS (Wang *et al.*, 2024; Heckroth *et al.*, 2021) and there is an urgent need for effective prevention and treatment programs in the clinic.

In this study, we explored the effect of IMB model-based care combined with danshen on patients undergoing LS, which has important reference value for clinical practice. First of all, comparing gastrointestinal function, we found that the research group had significantly shortened recovery of bowel sounds and first postoperative anal exhaust and bowel movement than the control group, with a markedly reduced incidence of repeated vomiting and sleep disturbances and lower GAS and MTL. It suggests that IMB model-based care combined with danshen can improve the gastrointestinal function of patients undergoing LS. We speculate that this is mainly due to the better alleviation of gastrointestinal stress responses in the research group. Clinical studies have shown that after surgery, the stress response of the human body will be obviously over-activated, causing a series of pathological changes (Milone *et al.*, 2021). Meanwhile, most LS patients require the establishment of a CO_2 pneumoperitoneum and transperitoneal inhalation of CO_2 may cause hypercapnia, leading to an exacerbation of the body's stress response (Humm *et al.*, 2021). In pharmacological studies of danshen, researchers have found that the chemosynthetic components of danshen have the ability to inhibit cellular oxidative stress and improve cardiovascular health in humans (XD *et al.*, 2019). These findings laid the foundation for danshen to improve stress trauma in LS. Also, because danshen has sedative and tranquilizing effects (Li *et al.*, 2022), this can also help patients relieve their negative emotions of anxiety and depression.

In TCM treatment, acupoint application is a characteristic treatment scheme that combines acupoint stimulation with drug action, which also makes it more effective and safe than a single therapy such as drug treatment or acupuncture (Gong *et al.*, 2024). Danshen is a very common medicine for promoting blood circulation and removing blood stasis in TCM, which is mainly used in the treatment of symptoms such as chest obstruction, heartache and abdominal pain (Xiao *et al.*, 2022). In gastrointestinal diseases, the use of danshen has been shown to have the effect of promoting blood operation and gastrointestinal peristalsis (Jiang *et al.*, 2023), so it also has a similar effect in patients undergoing LS. Neiguan acupoint is the confluence of eight extra channels in the human body, which communicates with the triple energizer meridian.

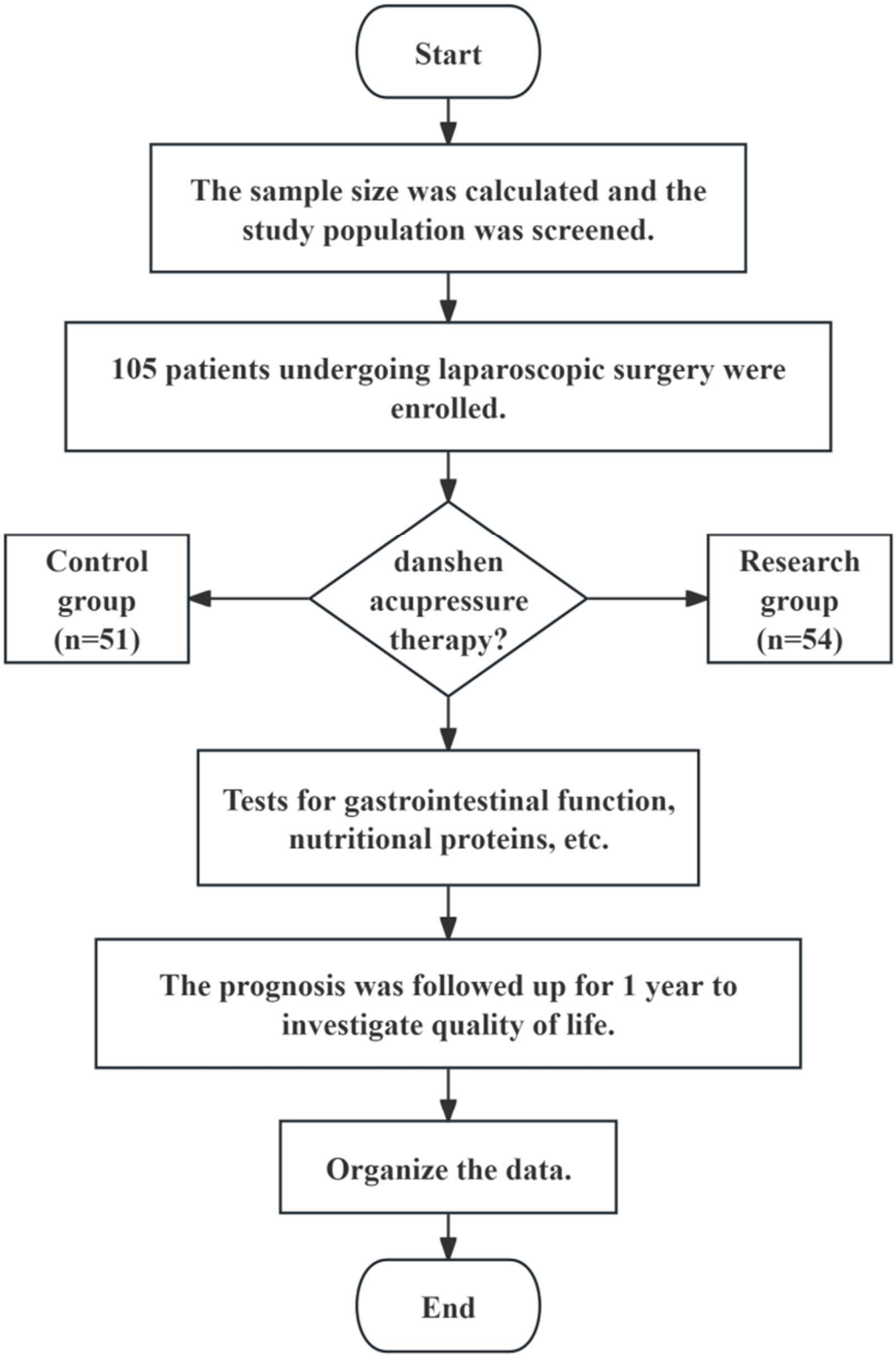

Fig. 1: Flow chart of this study.

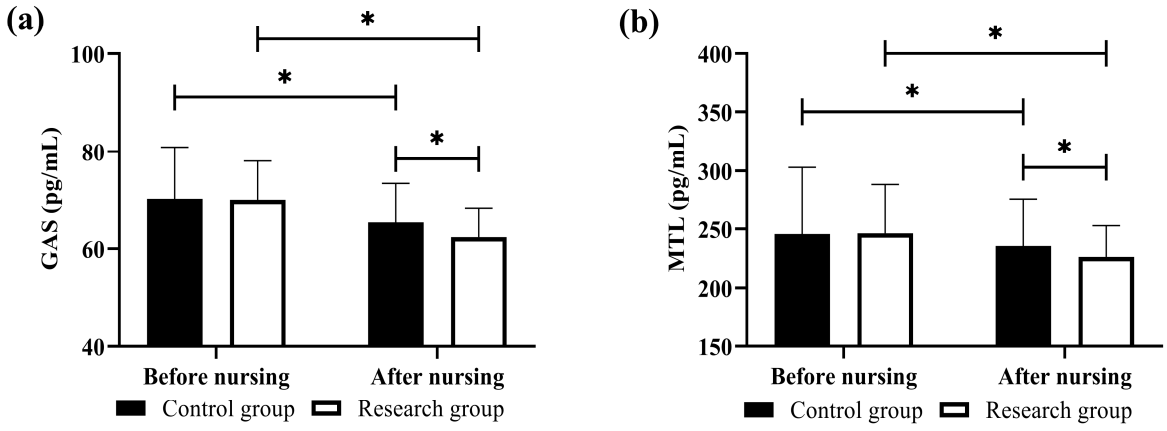

Fig. 2: Comparison of gastrointestinal mucosal function. (a) GAS, (b) MTL. * means P<0.05. Gastrin, GAS; Motilin, MTL.

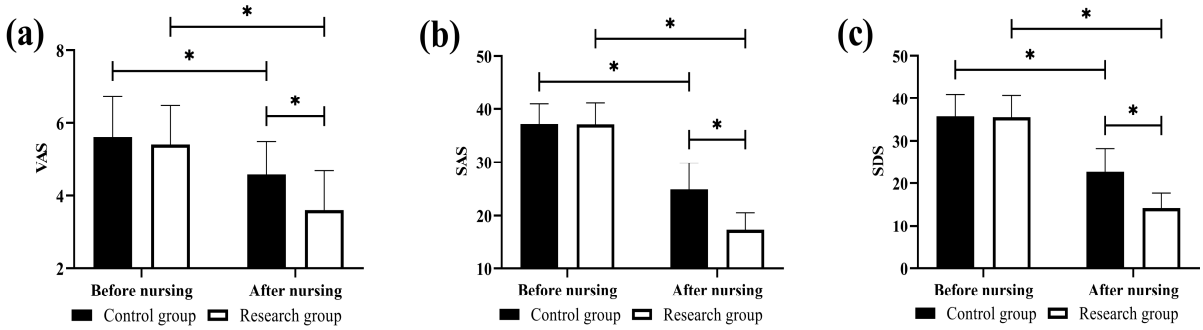

Fig. 3: Comparison of mental states. (a) PSQI, (b) SAS, (c) SDS. * means P<0.05. Self-Rating Anxiety Scale, SAS; Self-Rating Depression Scale, SDS; Pittsburgh sleep quality index, PSQI.

Table 1: Comparison of rehabilitation of gastrointestinal functions

Groups	Time for postoperative bowel sounds (h)	Time for postoperative first anal exhaust (h)	Time for postoperative first bowel movement (h)	Recurrent vomiting
Control group (n=51)	11.49±2.86	18.29±3.80	35.57±4.53	12 (23.53)
Research group (n=54)	8.91±1.53	11.31±2.94	22.46±5.22	4 (7.41)
t/χ^2	5.362	9.707	11.370	5.278
P	<0.001	<0.001	<0.001	0.022

Table 2: Comparison of complications

Groups	Rash	Infection	Itchy skin	Bloating	Total
Control group (n=51)	3 (5.88)	1 (1.85)	2 (3.92)	4 (7.84)	10 (19.61)
Research group (n=54)	1 (1.85)	0 (0.00)	1 (1.85)	1 (1.85)	3 (5.56)
χ^2					4.774
P					0.029

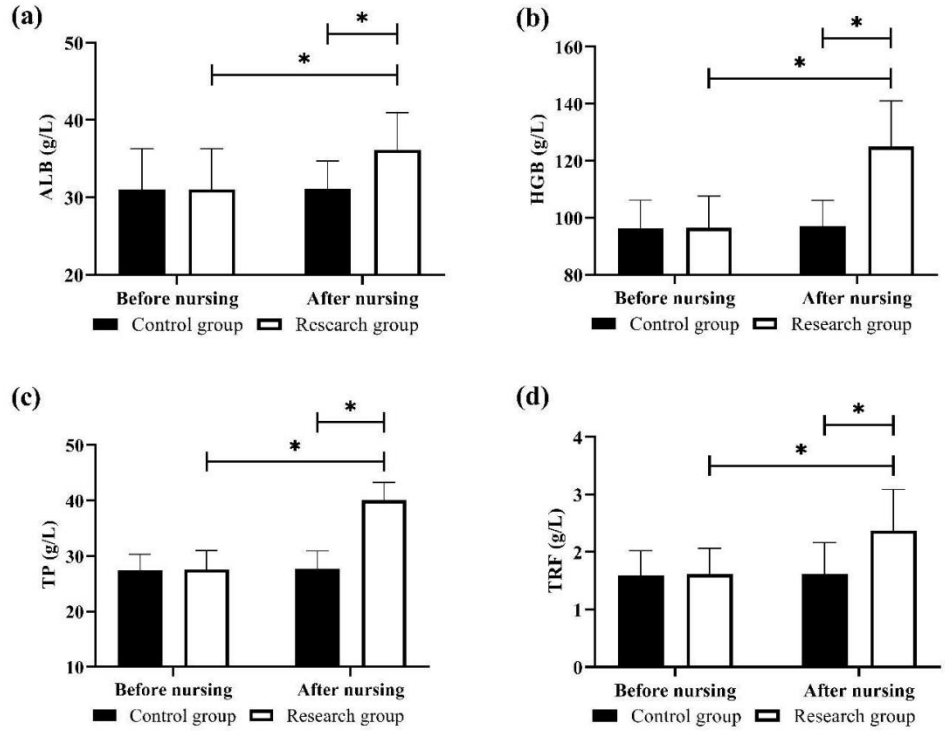

Fig. 4: Comparison of nutritional status. (a) ALB, (b) HGB, (c) TP, (d) TRF. * means P<0.05. Albumin, ALB; Hemoglobin, Hb; Total protein, TP; Transferrin, TRF.

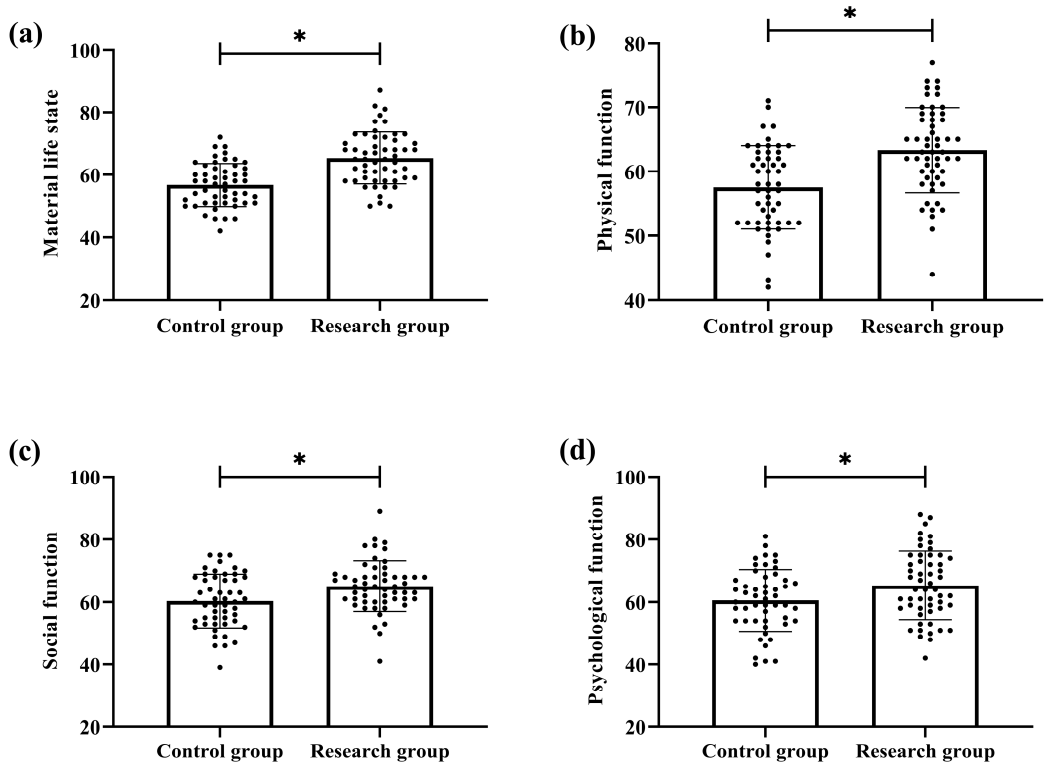

Fig. 5: Comparison of prognosis. (a) prognostic 1-year survival curve, (b) material life state score, (c) physical function score, (d) social function score, (e) psychological function score. * means P<0.05. Generic Quality of Life Inventory-74, GOOLI-74.

Stimulating this acupoint can effectively relieve spasms and pain, calm the adverse-rising energy and stop vomiting, playing a significant role in the treatment of stomach diseases (S. Chen *et al.*, 2024). Treatment with danshen by acupoint application can inhibit the stress response of the body and avoid the high-level release of gastrointestinal hormones. Moreover, acupoint application at the Neiguan points is effective in regulating the blood circulation system and gastrointestinal function (Zhang *et al.*, 2022). Acupoint application therapy is highly accepted by patients due to its non-trauma, low incidence of infection, high safety and simple operation (Li *et al.*, 2023). It is speculated that this is also the main reason for the lower incidence of complications in the research group compared with the control group. Further, we found more significantly enhanced nutritional status of patients in the research group, suggesting that IMB model-based care combined with danshen can also improve the nutritional status of patients. As we all know, the gastrointestinal tract is the most important digestive organ of the human body, as well as the main site for nutrient intake and absorption (Hiraki *et al.*, 2022). The influence of LS on gastrointestinal function will greatly reduce its nutritional metabolism and absorption capacity, resulting in a large loss of nutrition-associated proteins in most patients after the operation (Fan *et al.*, 2022). The combination of danshen can greatly improve the gastrointestinal function of patients and improve their health, so as to avoid postoperative complications and accelerate postoperative rehabilitation. This can also be confirmed by the higher quality of life scores in the research group when we investigated the postoperative quality of life of the two groups of patients. Similarly, IMB model-based care is indicated to improve the quality of life of patients undergoing surgery for cervical cancer (X. X. Chen *et al.*, 2024), which can also support our research findings. At the same time, danshen is also an excellent tranquilizing and sleep-aiding drug, in an animal test, researchers found that injecting danshen into mice can inhibit their voluntary activities and make the amplitude of the spontaneous generating activity of the cerebral cortex decrease (Su *et al.*, 2021). Pharmacological studies have also shown that tanshinone and tanshinol in danshen have a sedative effect, which can relieve tension and anxiety, thus improving sleep quality (Song *et al.*, 2023). Not only that, because danshen does not act directly on the central nervous system, but works by regulating the function of the endocrine system and the immune system, it is safe and does not increase the burden on any organ, which is one of the reasons for the lower incidence of adverse reactions in the research group.

However, due to the small number of cases in this study, there may be statistical analysis contingency. In addition, more objective indicators, such as inflammatory factors and immune factors, need to be included to evaluate the influence of danshen on patients undergoing LS. It is also necessary to extend the follow-up period to assess changes in patient outcomes.

CONCLUSION

Danshen can effectively improve the postoperative gastrointestinal function of patients with repeated vomiting and sleep disturbances after LS, improve their nutritional status and provide reliable security for their postoperative rehabilitation.

Availability of data and materials

The data that support the findings of this study are available from the corresponding author upon reasonable request.

Conflicts of Interest

The authors report no conflict of interest.

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