Research Square

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Multidisciplinary Nutrition Management Based on Enhanced Recovery after Surgery Protocols in Patients Undergoing Percutaneous Endoscopic Interlaminar Discectomy: A Randomized Controlled Clinical Trial

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Abstract

Background Few studies reported the impact of nutrition management based on Enhanced Recovery after Surgery (ERAS) protocols in spinal surgery. The aim of this study was to examine the association of multidisciplinary nutrition management in percutaneous endoscopic interlaminar discectomy (PEID) with patients' subjective feelings and postoperative recovery.

Methods A randomized controlled clinical trial was conducted from August to November in 2017. A total of 101 patients undergoing PEID were randomized into two groups: a control group (50 patients experiencing traditional nutrition management) and an intervention group (51 patients experiencing multidisciplinary nutrition management). Fasting time, subjective feelings, satisfaction and postoperative recovery were evaluated in all patients.

Results In all, 96 patients completed the study: 48 in each group. Our findings revealed that patients in intervention group had weaker preoperative hunger (p□0.036), preoperative thirst (p□0.001) and postoperative thirst (p□0.006), higher satisfaction about nutrition management (p□0.001), shorter pre and post-operative fasting liquids and solids time, and shorter first passage of flatus (p□0.005) than those of patients in control group.

Conclusion Multidisciplinary nutrition management can promote patients' subjective feelings and postoperative gastric recovery.

Trial registration: Current Controlled Trials ChiCTR-IOQ-17011742, June/22/2017.

Introduction

Enhanced Recovery after Surgery (ERAS) programs have been applied clinically over the past two decades since Danish Professor Kehlet H. put forward these protocols first [1–2]. ERAS consists of perioperative interventions, including preoperative education, minimally invasive surgery, early oral diet, optimal control of pain and early mobilization [3–4], that have been proven to decrease both physiological and psychological stress of elective surgery leading to reduce medical complications, promote postoperative recovery and satisfaction and cut down the length of hospital stay (LOS) and costs [5–10]. ERAS programs have developed as a very complete clinical pathway especially in colorectal surgery which guidelines have been published [11–13] and it has also been widely used in thoracic surgery [14], breast surgery [15], orthopedic surgery [16], gynecologic surgery [17], urological surgery [18]. By contrast, studies about ERAS in spinal minimally invasive surgery are much fewer.

In ERAS programs, compared to no routine bowel preparation, minimally invasive surgery, no routine uses of gastric tube, urinary catheter and drainage tube, shortening fasting time especially preoperative fasting isn't carried out strictly just as the Guidelines which recommend the intake of clear fluids about 2 h before the anesthesia as well as a fasting period of 6 h for solids and encourage early oral diet [11–13]. Investigative researches in America [19], Oman [20], Botswana [21], Turkey [22] and China [23] showed

that the preoperative fasting solids time are respectively 14 h, 12.1 h, 15.9 h, 14.7 h and 15.8 h, as well as the preoperative fasting liquids time are respectively 12 h, 11.9 h, 15.3 h, 11.25 h and 5.36 h. The study in 69 elective surgical children showed that the real time of drinking and eating after surgery were apparently later than those of their first requirement for drinking and eating [24]. And meanwhile, surgical patients usually have to suffer hunger, thirst, dry mouth, anxiety and other discomforts [25]. The poor perioperative nutrition management might be because the impact of shorter fasting time isn't so huge and obvious and clinical surgery is complex and flexible. Patients' tolerance and ignorance are also the factors [26]. However with the researches about nutrition, we know that it plays a more and more important role during the surgery. Nutrition not only could supply energy for the body, but also could modulate the inflammation, optimize blood glucose control, decrease stress response and supply multiple elements for wound healing and postoperative recovery [27–29].

Lumbar disc herniation (LDH) is one of the lumbar degenerative diseases, whose main symptoms are low back pain and radioactive lower limb pain. LDH can not only affect patients' daily life badly, but cause heavy medical and social burden [30–33]. With the medical development, percutaneous endoscopic interlaminar discectomy (PEID) has become one of the most widely used minimally invasive surgeries, which can reduce the body's stress reaction as much as possible by reducing the surgical trauma [34]. However, its perioperative nutrition management was traditional and hysteretic.

Thus, we conducted a randomized controlled clinical trial in LDH patients undergoing PEID to determine whether complete, scientific and multidisciplinary nutrition management based on the Guidelines really dose play an important role during the perioperative period, in which we compared subjective feelings, satisfaction and postoperative recovery in different groups. We hypothesized that compared to a traditional nutrition management, a multidisciplinary nutrition management would promote patients' subjective feelings and postoperative gastric recovery.

Materials And Methods

Study design

This study was a randomized controlled clinical trial. This study protocol was approved by the Ethics Committee of West China Hospital of Sichuan University (Chengdu, China). Written informed consents were obtained from the patients and their families. This study was registered under chictr.org, identifier number ChiCTR-IOQ-17011742.

Participants

In this study, we recruited 101 lumbar disc herniation patients undergoing PEID from August to November in 2017, in the Department of Orthopedics, West China Hospital of Sichuan University, a tertiary-level teaching hospital in southwest China. They were randomly divided into two groups. During perioperative period in the research, there were 51 patients who experienced multidisciplinary nutrition management in

intervention group and 50 patients who experienced traditional nutrition management in control group. The inclusion criteria were: lumbar disc herniation patients undergoing PEID, patients who could experience the whole nutrition management according to the plan. The exclusion criteria were: patients who couldn't eat orally, such as oral diseases, dysphagia and esophageal stenosis, patients who couldn't tolerate our own nutritional product.

Interventions

The intervention protocols of the control group were traditional nutrition management during perioperative period. They were as follows: preoperative assessment without nutrition assessment, normal meal until up to 8–12 hours before the surgery and normal drinking until up to 4 hours before the surgery, oral feeding started gradually 4–6 hours after awaking from surgical anesthesia if there was not any discomfort.

The intervention protocols of the intervention group were multidisciplinary nutrition management during perioperative period. They were as follows: We built the multidisciplinary team including Spine Surgery, Nutrition Department, Department of Anesthesiology and Operating Room and determine everyone's duties. Clinical dietitian formulated nutrition interventions for malnourished patients and developed four kinds of nutritional products (Table 1) for all the patients in intervention group. And they also solved problems about feeding nutritional products. We trained our team staff to promote the cooperation. Especially for ward nurse, operating room nurse and anesthesiologist, they knew the time of patients' oral feeding and surgery very well. So that operation could be conducted successfully according to the plan. We implemented specific nutrition management interventions (Table 2).

The same interventions were applied in both groups: no routine bowel preparation, no routine use of gastric tube, urinary catheter and drainage tube, avoiding intraoperative hypothermia, postoperative glycaemic control and early and scheduled mobilization.

Discharge criteria including the following: normal vital signs, recovery of bowel function, adequate oral feeding and mobilization, good pain control and tolerance, and acceptance of discharge by patients. Patients were followed up by outpatient guidance or telephone within 1month after discharge. Patients in different groups were arranged in different wards in order to minimize protocol contamination.

Outcome Measures

The primary outcomes were gastrointestinal subjective feelings and satisfaction about nutrition management. Gastrointestinal subjective feelings included preoperative and postoperative hunger, thirst, nausea and vomiting degree. These feelings were assessed by numerical rating scale from 0 to 10. 0

meant that patients didn't have this feeling and 10 meant the feeling was so strong that patients couldn't tolerate. Satisfaction about nutrition management was from 0 to 100 including five kinds of satisfaction, taste, price, preoperative and postoperative hungry and thirsty degree, nurse's care for nutrition requirement and nurse's nutrition education.

Secondary outcomes were fasting time and postoperative recovery. Fasting time included preoperative solid and liquid fasting time and postoperative solid and liquid fasting time. From Guidelines [35], preoperative fasting time is defined as a prescribed period of time before the surgery when patients aren't allowed the oral intake of solids or liquids and postoperative fasting time is defined as the same period of time after the surgery. Postoperative recovery included first urination, first out-of-bed activity, first passage of flatus and lumbar function recovery assessed by Oswestry disability index (ODI).

We collected patients' baseline demographics and the ODI scores before surgery, fasting time, subjective feelings, postoperative recovery and the ODI scores on the 2nd day after surgery and the ODI scores on the 30th day after surgery.

Sample Size And Randomization

Sample size was calculated by pre-test outcome and sample size estimation formula. In pre-test, the scores of nutrition management satisfaction in all patients, control group and intervention group were respectively (87.10 ± 6.758), (84.80 ± 7.068) and (89.40 ± 5.892). The formula was as follow:

$n1 = n2 = 2[(Z\alpha/2 + Z\beta)\sigma/\delta]2$, $\alpha = 0.05$, $\beta = 0.1$, $\sigma = S = 6.758$, $\delta = 89.40 - 84.80 = 4.60$. And considering the loss of visit, we calculated the number of required patients in each group was about 45–54.

Patients we recruited were randomly divided into two groups by using random number table generated by computer. The group information was preserved in a sealed envelope by a research assistant. When a patient who met inclusion and exclusion criteria was admitted, he or she would be divided into control group or intervention group by the group information.

Statistical Analyses

We input data using Microsoft Excel and used SPSS 20.0 for statistical analysis. We used mean ± SD to express numerical variables and frequency or percentage to express categoric variables. Differences between two groups were tested by t test for normally distributed data and rank test for non-normally distributed data. Compare in discrete variables were tested by Chi-square test and Fisher's exact test. A value of p□0.05 was considered statistically significant.

Results

Baseline demographics and perioperative variables

In our study, a total of 98 patients finished the whole process including 48 patients in intervention group and 48 patients in control group. There were 5 patients couldn't be analyzed for outcome (Fig. 1). Patients in two groups had comparable baseline demographics and perioperative variables, including age, gender, body mass index (BMI), lesion segment, albumin, hemoglobin, blood glucose, American Society of Anesthesiologists (ASA), length of stay (LOS) and cost. And there were not statistically significant differences between these two groups about above information (P□0.05) (Table 3).

Subjective Feelings

Perioperative patients have to tolerate body's stress-response because of the operative trauma and fear. Long fasting would exacerbate stress-response and the most obvious is that almost all of them would suffer hunger and thirst. Along with those, some would feel nervous, anxious and annoyed. And above these negative feelings would influence postoperative recovery. In our study, patients in intervention group experienced shorter fasting time and the degrees of their preoperative hunger and thirst were obviously less than those in control group. And our findings support the findings of the previous work. Researches of De Jonghe [36] and Tsutsumi [37] proved that shortening preoperative fasting time could relieve hunger and thirst before the surgery. These are supported by physiological studies. Concentrations of nutrient content such as glucose, fat and water would decrease while the body keeps fasting for a period of time. With nerves carrying signals, feeding center and drinking center in hypothalamus would be stimulated. So the stomach would shrink and the body would feel hungry. And with the thirsty signal, we want to drink water. According to the gastric emptying time of different kinds of food, it's appropriate to set the preoperative fasting solids time up to 6 h and fasting liquids time up to 2 h. Carey's qualitative research found that thirst was the most serious physiological effect generated by fasting and dry mouth could lead to chapped lip, dry oral mucosa, swollen tongue and dry throat [25]. Patients said that they hoped to get water, ice or even intravenous infusion to relieve thirst.

In our study, no statistically significant differences were detected in postoperative hunger. This is not consistent with some published studies, which found that the number of ERAS group patients undergoing hip and knee replacements who felt postoperative hungry was clearly fewer than that of control group [38]. A possible explanation for this might be the differences in specific postoperative feeding time in different studies and different tolerance among different population as well. And we also thought this might be connected with non-extinctive anesthetic effects and patients' supine position. However, patients in intervention group felt less thirsty and all of patients in our study expressed that their postoperative thirst was more serious than preoperative thirst. Except for fasting liquids, patients' throats suffered injuries more or less because of airway intubation and degree of dry mouth increase because mouth couldn't be closed completely during the operation. Perrott et al found that 76% children suffered from postoperative thirst and 41% children suffered from sore throat after post-anesthesia sobriety [39]. So early drinking can promote oral comfort.

Previous theory thought that early feeding could cause nausea and vomiting because of anesthetic effect. And subsequent researches have denied it. Based on ERAS, minimally invasive surgery and rapid short-acting anesthetic have really worked a lot on reducing nausea and vomiting. And in our study, occurrence rates of postoperative nausea and vomiting in all of patients were extremely low and there were not statistically significant differences between two groups. Traga studied in 115 patients undergoing pancreaticoduodenectomy and obtained the same findings as ours [40].

Satisfaction About Nutrition Management

We investigated patients' satisfaction about nutrition from five parts, including taste, price, preoperative and postoperative hungry and thirsty degree, nurse's care for nutrition requirement and nurse's nutrition education. They were from our previous talk with patients and other published studies. Patients focused more on the taste and price of our own nutritional products. If the taste and the price were not satisfactory, they preferred not feeding. So we made some adjustments for the study. Thiele et al divided the whole satisfaction into 15 aspects and the satisfaction of ERAS group patients in nurse's attention, nurse's attitude and nurse's education were respectively 93%, 73% and 77%. Patient-oriented concept has been focused more [5].

In our study, patients in intervention group had higher satisfaction might be involved in following several reasons. Firstly, intervention group patients felt much less hungry and thirsty than control group patients. De Jonghe and Carey emphasized thirst as an important issue for patients' comfort and meet [25, 36]. It's really terrible for fasting patients not to have a wet and clean mouth without enough saliva. Last but not least, multidisciplinary nutrition management did work a lot, especially about medical staff's nutritional guidance and education. A Kenyan research showed that only 6.2% patients knew why they should fast before the operation [26]. Qiu XY et al indicated that most patients just kept fasting passively no matter how long it was [41]. So we can see that knowledge patients know about therapy and nursing is very limited. Medical staff should meet patients' sensitivity and communication needs by our thorough knowledge and positive attitude [42]. Sibbern's systematic review mentioned that information about operation before the surgery and postoperative recovery guidance after discharge had the greatest demand [43–45].

Fasting Time

Recommendations for preoperative fasting are important issues and becoming clearer with the more and more clinical researches about ERAS [36]. From the Guidelines of American Society of Anesthesiologists Committee, it's appropriate to fast from intake of clear liquids at least 2 hours before surgery and to fast from intake of a light meal or nonhuman milk at least 6 hours before surgery [35]. Present physiological researches have tested it. Firstly, different kinds of food in the stomach have different gastric emptying time. The half-time of water gastric emptying is about 10–20 minutes and it would take 4–6 hours for solid food to be emptied in the stomach. So we can see that the time is accorded with the Guidelines.

Secondly, our stomach has so strong expansibility that gastric internal pressure doesn't rise even if there is a little gastric content. So it's safe and scientific for patients undergoing elective surgery to shorten preoperative fasting time based on Guidelines. However, the process of surgery is changeable and unpredictable accurately, medical staff have to shorten the fasting time as much as possible. And the real practice time is still longer than the recommendations. De Jonghe et al suggested that in order to increase the surgery's flexibility, it was better to ask patients to take carbohydrate diet 3 hours before surgery rather than just 2 hours [36].

About postoperative fasting time, early oral feeding has been also proved safe and necessary. Researches showed that intestinal mucosa permeability increases after surgery and early enteral nutrition can increase nutrient absorptivity. Early oral feeding can correct malnutrition and facilitate gastrointestinal peristalsis and postoperative recovery. In our study, we encouraged patients in intervention group to start drinking water and our own nutritional product C. It tastes kind of sour and it can promote gastrointestinal peristalsis and increase appetite.

Postoperative Recovery

In our study, no statistically significant differences were detected in the time of first urination and first out-of-bed activity. These results can be explained by the same procedures except nutritional management, including no routine use of gastric tube, urinary catheter and drainage tube. Therefore, all of patients could exercise out of bed and go to urinate.

However, our nutritional intervention did affect patients' gastrointestinal recovery. We found that patients in intervention group had shorter time of first flatus. This finding is agreement with those of Zhou who found that patients who fed earlier had shorter time of first flatus and defecation in the research of 316 gastric cancer patients undergoing colorectal anastomosis [46]. Gastrointestinal tract is not only a place for digestion and absorption but also a biological barrier that need enough blood supply. Intestinal mucosal cells have so poor tolerance of ischemia that their growth, proliferation and rehabilitation need nutrients supplied by chyme directing contact with the intestinal mucosa [188]. Thus, long fasting time is an apparent disadvantage that might bring about bacteria translocation, dysbacteriosis and intestinal microenvironment disorders [47]. In our study, patients awake after the operation in intervention group could drink nutritional liquid about 200 ml that could nourish intestinal mucosa and promote generating cell growth factors [48–49].

And for lumbar function recovery, we did not find that our multidisciplinary nutrition management interventions played a role. Of course, the operation did. So nutrition management mainly affected patients' subjective feelings and satisfaction in-patient.

Discussion

Our study is a randomized controlled clinical trial investigating the application and evaluation of multidisciplinary nutrition management in lumbar disc herniation patients undergoing percutaneous endoscopic interlaminar discectomy. We found that in contrast to traditional nutrition management, our multidisciplinary nutrition management including nutrition risk assessment, shorter fasting time, feeding oral nutritional products and nurse's education about perioperative nutrition could effectively improve PEID patients' subjective feelings and nutrition management's satisfaction and could also effectively promote recovery of intestinal function and shorten the time of first flatus. But we didn't find the association of our intervention with the recovery of lumbar function.

Strengths And Limitations

The nutritional products generated by our own clinical nutrition department is the key in the study. They can meet patients' needs in perioperative period, such as supplying calorie, relieve hunger and thirst, promote experience in-patient and improve postoperative recovery. In the further study, we plan to optimize recipes and tastes for routine clinical use.

Our study has several limitations. First, our sample were just from only one hospital. In the further study, we suggest sampling from different levels hospitals in order to show the advantages of our nutrition management. Second, our interventions just covered hospitalization. We suggest extend it from out-patient to postoperative follow up. We hope patients can do somethings for their disease not just relying on the operation. Third, we couldn't collect the time of first defecation because most patients didn't defecate before their discharge on the second day after operation.

Conclusion

Multidisciplinary nutrition management can effectively promote patients' subjective feelings and postoperative gastric recovery. But it can't affect the recovery of lumbar function.

Abbreviations

ERAS: Enhanced Recovery after Surgery; PEID: Percutaneous endoscopic interlaminar discectomy; LOS: Length of hospital stay; LDH: Lumbar disc herniation; ODI: Oswestry disability index; BMI: Body mass index; ASA: American Society of Anesthesiologists

Declarations

Acknowledgement

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Authors' contributions

NN and JC conceived the research idea and designed the research; JC wrote the manuscript; XZ, PL and YZ contributed to the statistical analysis and data collection. All authors have read and approved the final version of the manuscript.

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Availability of data and materials

The datasets analysed in the current study are available from the corresponding author on reasonable request.

Ethics approval and consent to participate

The study was approved by my institution (201782). All participants provided informed consent, and all rights of the participants were protected.

Consent for publication

Written informed consent for publication was obtained from all patients.

Competing interests

There is no any potential competing interest.

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Tables

Table 1. The ingredients and function of four kinds of nutritional products

Nutritional products	Feeding time	Ingredients	Calories	Function
A (Solid powder)	6h before surgery	Protein, fat, carbohydrate, inorganic salt	300Kcal	Providing energy for surgery and lowering patients' hunger and thirsty
B (Solid powder)	2h before surgery	carbohydrate, inorganic salt	200Kcal	Reducing postoperative insulin resistance and avoiding the risk of anesthesia
C (Liquid)	after awaking from surgical anesthesia	inorganic salt	200ml	Promoting gastrointestinal peristalsis and increasing appetite.
D (Solid powder)	At night on the surgery day	Protein, fat, carbohydrate, inorganic salt, dietary fibre	315Kcal	Providing energy for postoperative recovery

Table 2. Multidisciplinary nutrition management interventions based on ERAS in intervention group

Time	Interventions
2-5 days before surgery	a. After admission, patients experienced specialist assessment and preoperative examination.
	b. Patients were assessed by nurses about their nutritional status using Nutrition Risk Screening 2002. If the score≥3, it showed that the patients had nutrition risk and they should be given nutritional intervention. If the score□3, it showed that they didn't have nutrition risk and then could enter the ERAS clinical pathway.
	c. The surgeon arranged elective operation for patients who didn't have nutrition risk.
	d. The clinical dietitian developed four kinds of nutritional products for elective surgery patients.
0-1 days before surgery	a. Patients were asked to take a bag of nutritional product A that contained protein and carbohydrate until up to 6 hours before elective surgery and a bag of nutritional product B that only contained carbohydrate until up to 2 hours before elective surgery.
During the operation	a. The surgeon conducted PEID.
After surgery on the surgery day	a. After awaking from surgical anesthesia, patients could drink water slowly and a bag of nutritional fluid C that could increase their appetite. If there was no any discomfort, they could begin normal diet gradually.
	b. In the evening, patients were asked to take a bag of nutritional product D that could add energy and protein on the surgery day.
The day after the surgery day	a. Before discharge, patients were assessed again by nurses about their nutritional status. Only every aspect was up to standard, patients were allowed to discharge.

Table 3. Baseline demographics and perioperative variables

Characteristic	Control (n_1=48)	Intervention (n_2=48)	*P*
Age（y）	43.50±15.58	44.60±15.13	0.725
Gender（*n*.）			
Male	32（66.7%）	31（64.6%）	0.830
Female	16（33.3%）	17（35.4%）	
BMI（kg/㎡）	24.45±3.20	23.26±3.21	0.073
Lesion segment（*n*.）			
L_{1-2}	2（4.2%）	2（4.2%）	1.000
L_{2-3}	5（10.4%）	6（12.5%）	0.749
L_{3-4}	13（27.1%）	12（25.0%）	0.816
L_{4-5}	38（79.2%）	33（68.8%）	0.245
L_5-S_1	32（66.7%）	40（83.3%）	0.059
Albumin（g/L）	45.72±3.48	45.29±4.42	0.604
Hemoglobin（g/L）	143.04±12.08	143.29±14.21	0.926
Blood glucose（mmol/L）	5.11±0.50	5.03±0.49	0.458
ASA（*n*.）			
2	42（87.5%）	44（91.7%）	0.504
3	6（12.5%）	4（8.3%）	
LOS（d）	6.40±1.25	6.38±1.91	0.950
Cost（RMB）	26618.88±2022.04	26273.74±1461.41	0.341

BMI：body mass index; ASA：American Society of Anesthesiologists; LOS：length of stay.

Table 4. Comparison of subjective feelings

Subjective feelings	Control group (n_1=48)	Intervention group (n_2=48)	*Z*	*P*
Preoperative hunger	3（1.25,4）	2（0,4）	-2.091	0.036*
Preoperative thirsty	4（3,5)）	1（0,3）	-5.497	＜0.001*
Postoperative hunger	0（0,3）	1（0,3）	-0.242	0.808
Postoperative thirsty	5（4,6）	4（3,5）	-2.728	0.006*
Postoperative nausea	0（0,0）	0（0,0）	-0.069	0.945
Postoperative vomiting	0（0,0）	0（0,0）	-0.015	0.988

Variables were expressed as Median (Quartile)

* p＜0.05

Table 5. Comparison of Satisfaction about nutrition management

Variables	Control group (n_1=48)	Intervention group (n_2=48)	*t*	*P*
Satisfaction	86.73±5.55	90.79±5.52	-3.597	0.001*

Variables were expressed as mean ± SD

* p＜0.05

Table 6. Comparison of fasting time

Fasting time（h）	Control group (n_1=48)	Intervention group (n_2=48)	*t*	*P*
Preoperative solid fasting time	14.25±2.96	8.24±1.57	12.436	＜0.001*
Preoperative liquid fasting time	9.40±2.42	4.08±0.86	14.340	＜0.001*
Postoperative liquid fasting time	2.98±1.25	1.50±0.64	7.306	＜0.001*
Postoperative solid fasting time	5.07±0.84	3.23±1.19	8.780	＜0.001*

Variables were expressed as mean ± SD

* p□0.05

Table 7. Comparison of postoperative recovery

Postoperative recovery□h□	**Control group (n_1=48)**	**Intervention group (n_2=48)**	***t***	***P***
first urination	2.67±0.90	2.91±1.09	-1.174	0.243
first out-of-bed activity	2.68±0.86	2.99±1.17	-1.488	0.140
first passage of flatus	8.46±3.55	6.33±3.63	2.897	0.005*

Variables were expressed as mean ± SD

* p□0.05

Table 8. Comparison of lumbar function recovery

	Preoperative ODI(%)	POD 2 ODI(%)	POD 30 ODI(%)
Control group (n_1=48)	53.24±14.15	38.43±6.59	10.46±5.82
Intervention group (n_2=48)	49.77±15.01	38.19±9.63	9.91±5.12
Nutrition management	F=1.160	P=0.284	
Time/surgery	F=460.288	P□0.001*	
Interaction	F=0.823	P=0.441	

ODI□Oswestry disability index; POD□Postoperative day.

Variables were expressed as mean ± SD

* p□0.05

Figures

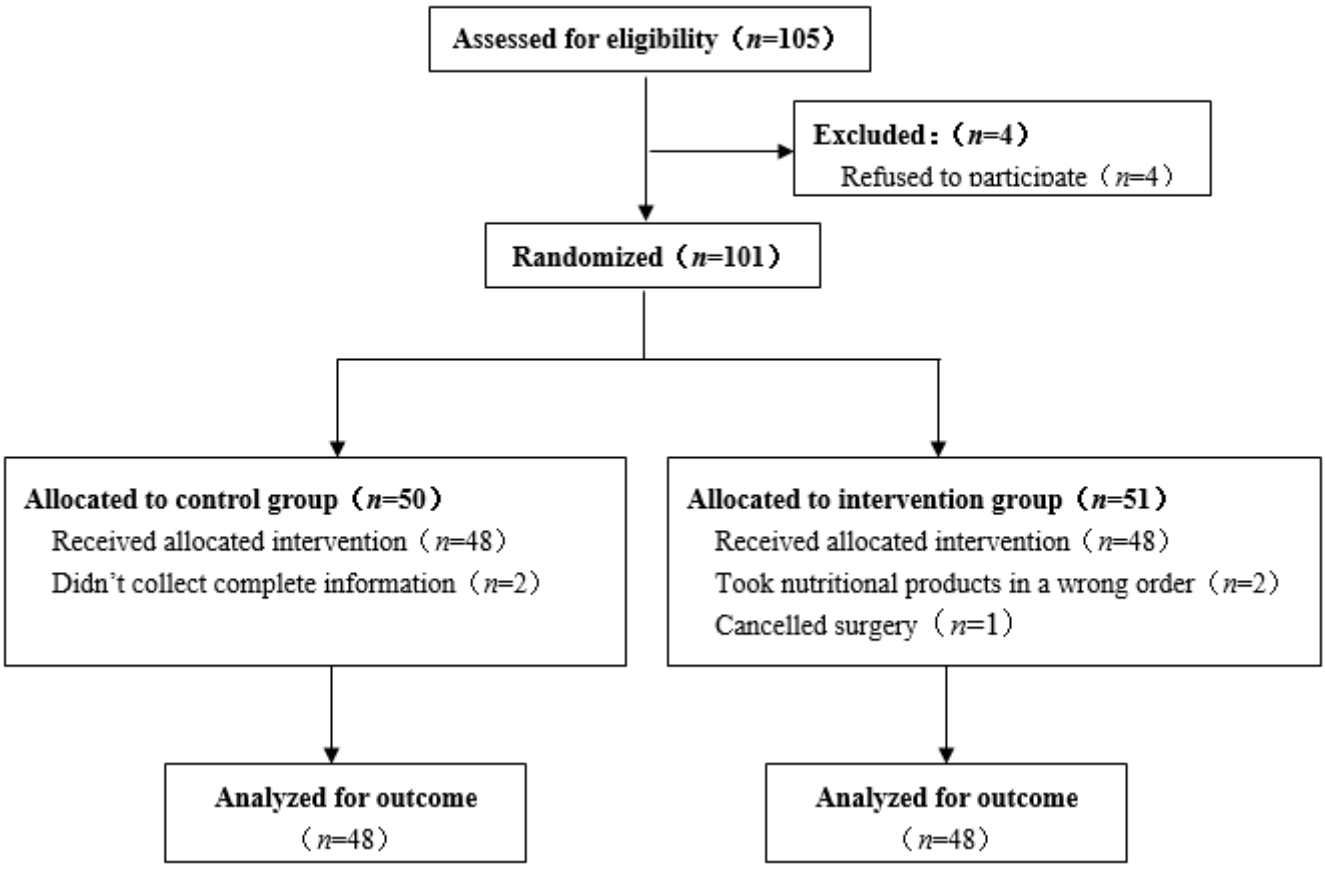


Figure 1

Flow chart depicting numbers included in enrolment, allocation, follow-up and analysis

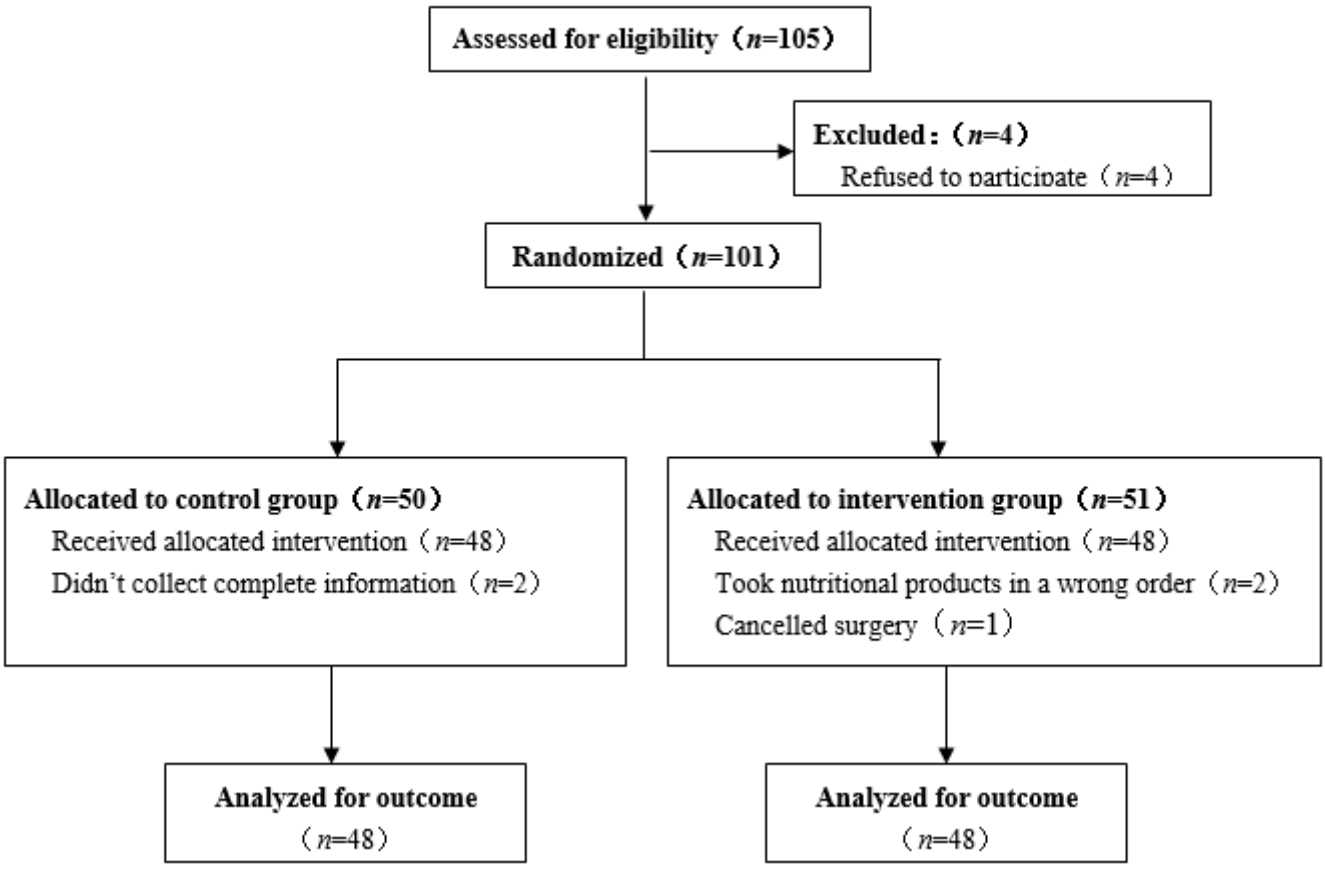


Figure 1

Flow chart depicting numbers included in enrolment, allocation, follow-up and analysis

Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- CONSORTchecklist.pdf
- CONSORTchecklist.pdf