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Review Article

Effects of predictive nursing on delirium after spinal surgery

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Abstract: Objective: To explore the effect of predictive nursing on the incidence of delirium and postoperative recovery in patients undergoing spinal surgery. Methods: One hundred and eighty patients who underwent spinal surgery by the posterior approach in our hospital from January 2017 to July 2019 were selected, among whom 100 patients in the study group (SG) were treated with predictive nursing and 80 patients in the control (CG) were treated with traditional nursing. The operative indications (hospitalization time, operation time), the incidence of postoperative delirium, the levels of epinephrine, norepinephrine and pressure injury, and the neurological function recovery (NIHSS and SSS score) were compared between the two groups. The mental health of the two groups after nursing (SAS, SDS score) was compared, and the total effective rate and postoperative satisfaction of patients in the two groups were investigated. Results: The SG was better than the CG in terms of surgical indications, and the number of patients with postoperative delirium in the SG was less than that in the CG. Compared with the CG, the scores of epinephrine and norepinephrine, NIHSS and SSS, SAS and SDS were lower in the SG, the probability of pressure injury was lower, and the total effective rate and satisfaction were higher. Conclusion: Predictive nursing can reduce the incidence of postoperative delirium by reducing anxiety and depression and restoring nerve function in patients after spinal surgery, so that patients can recover better after spinal surgery.

Keywords: Predictive nursing, spinal surgery, delirium

Introduction

Spinal surgery, such as endoscopic spine surgery, plays an important role in the treatment of diseases such as intervertebral disc herniation, radiculopathy, myelopathy, degeneration or trauma-induced instability, infection, and tumors [1, 2]. During spinal surgery, it is necessary to reduce any muscle compression injury caused by prolonged retraction, avoid soft tissue exfoliation and muscular innervation, and minimize bone resection, so as to prevent iatrogenic instability and utilize targeted surgical access in spinal pathologies [3]. However, after surgery, a series of complications such as postoperative infection [4, 5] and delirium [6, 7] can occur.

Delirium is a common disease after surgery usually found in the elderly with far-reaching effects, which can lead to longer hospital stay, resulting in functional decline and postoperative cognitive dysfunction, and even an increased risk of dementia and death [8-10]. The complexity of surgery and the intensification of population aging make postoperative delirium a more common complication after spinal fusion [11, 12]. Therefore, postoperative nursing is essential for the rehabilitation of patients, as high-quality nursing services can effectively relieve patients' mental problems and improve the treatment effects [13]. Among them, predictive nursing is a type of high-quality nursing modality, which initiates the promise of evidence-based medicine and summarizes the characteristics of different diseases and the patients' individual characteristics, needs and behaviors. It is guided by a new medical model that provides a comprehensive interven-

tion in patients' with the social, psychological and physical health of patients as a priority [14-16]. However, there is little research on the effects of predictive nursing on delirium in patients after spinal surgery. Therefore, the purpose of this experiment is to study how this nursing method affects the postoperative recovery of thses patients.

Methods

General information

A total of 180 patients who underwent spinal surgery by the posterior approach in the Mater nal and Child Health Hospital from January 2017 to July 2019 were selected. There were 100 patients in the study group (SG), including 53 males and 47 females, aged 58-81 years, with an average age of 69.45±3.31 years and an average course of disease of 25.95±1.87 months. The control group (CG) consisted of 80 patients (45 males and 35 females), aged 60-77 years, with an average age of 70.14±3.75 years and an average course of disease of 26.35±1.73 months. Inclusion criteria: Patients who met the surgical indications, and those without communication disorders, coagulation disorders or diseases affecting this study. The patients and their families agreed to participant in this study and signed an informed consent. Exclusion criteria: Patients who had severe cardiopulmonary problems that could not withstand the operation; patients with other diseases that had an impact on the study; patients with communication problems. This study was approved by the Medical Ethics Committee of the Maternal and Child Health Hospital and this study was in line with the Declaration of Helsinki.

Methods

Patients in the CG received routine nursing. The medical staff explained the postoperative matters needing attention to the patients in detail, guided them in terms of diet, instructed them to take medicine in accordance with the doctor's advice, and urged them to be reexamined on time. The SG carried out predictive nursing in addition to that of the CG. To a large extent, a series of complications such as postoperative delirium were due to the lack of relevant knowledge of patients and their families, so medical staff first conducted health education for patients and their families. The nursing staff explained in detail to the patients and their families the causes of postoperative delirium and other complications, as well as the corresponding prevention and treatment measures, so as to enhance their disease awareness. Then the patient's condition was assessed to evaluate the risk of delirium. The nursing staff reviewed the patient's case data in detail to quickly understand his/her psychological state changes during the nursing process, and actively communicated with him/her to eliminate a variety of negative emotions such as anxiety and fear induced by disease and surgery. For high-risk patients, the nursing staff tried to avoid the lower limb venous infusion, so as not to damage the vascular intima. In addition, the nursing staff also followed the doctor's advice to give high-risk patients antiplatelet aggregation drugs to monitor the arterial blood gas. During the operation, the patient was subjected to a blood gas analysis to carefully observe the balance of water-electrolytes, the amount of hemoglobin and the partial oxygen pressure. Furthermore, the pain degree of the patients was evaluated correctly, and the time and dosage of intraoperative analgesia were recorded in detail to avoid respiratory depression caused by excessive analgesia. After the operation, the patients were given preventive nursing intervention, and the nurses assisted the patient with early passive or active rehabilitation training to promote the blood circulation of the lower extremities. During the training, the nurses also paid attention to the changes in the temperature and color of the skin of the affected limbs, and informed the attending physician in real time if there were any abnormalities. What's more, in a timely manner nurses designed a more reasonable diet based on low-cholesterol, low-salt and low-fat foods, which could reduce the blood viscosity of patients. Moreover, when actively talking to the patient after surgery, comforting words and cues were used by the nursing staff, supplemented by music to relieve pain and anxiety of the patient.

Detection indicators

Surgical indications. Surgical indications, such as hospitalization time and operation time were observed and compared between the two groups.

Incidence of postoperative delirium. The post-treatment POD of patients in the two groups was evaluated by confusion assessment method (CAM) [17]. The number of patients with POD one hour after exuctation, one day and two days after surgery was recorded in detail, and the incidence of postoperative delirium was compared.

Epinephrine and norepinephrine levels. Upon admission, and 3 days and 14 days after surgery, 5 mL of blood was drawn from patients to detect the levels of epinephrine and norepinephrine.

Pressure injury. Skin compression (color, integrity, exudation, touch) of all the patients with spinal internal fixation surgery were evaluated, observed, and compared. Based on the stage of pressure injury, the clinical efficacy of the two groups of patients after nursing intervention was evaluated according to the following criteria. Stage 1: after reexamination, the patient's skin was intact and accompanied by pressure-invariant white and red spots; or stage 2: patients with partial skin defect and exposed dermis with complete or damaged serous blisters.

Neurological function and mental health. National Institute of Health stroke scale (NIHSS) [18] and Scandinavian Stroke Scale (SSS) [19] were adopted to evaluate the neurological functional recovery of patients in the two groups. The better the patient's neurological function, the lower the score. Self-rating anxiety scale (SAS) [20] and self-rating depression scale (SDS) [21] were used to evaluate the mental health level of patients in groups A and B before nursing and one month after nursing (20 items, 0-100 points). The worse the mental health of the patients, the higher the score.

Total efficiency. The clinical nursing effects of the two groups were observed. (1) Markedly effective: the operation was successful, and there were no complications, nor adverse events such as field blood oozing and secondary injury. (2) Effective: the operation was basically successful, with minor complications. (3) Ineffective: the operation was unsuccessful, accompanied with complications and other adverse events. Total effective rate= (markedly effective + effective)/total number of cases × 100%.

Comparison of treatment satisfaction between the two groups. The treatment satisfaction questionnaire, whose contents and evaluation criteria were self-designed, was utilized to test the patients' satisfaction with the treatment, and the treatment satisfaction scores of the two groups were compared. The total score was 100 points, of which a total of 85 points was deemed satisfied, more than 60 points was basically satisfied, and less than 60 points was dissatisfied.

Statistical methods

SPSS 19.0 (Asia Analytics Formerly SPSS China) was employed for comprehensive data statistical analysis. The counting data were analyzed by chi-squared, and the measurement data were recorded as (X±SD). The statistical analysis of two time points were performed by t test, while that of multiple time points were conducted by two-factor analysis of variance between two groups. $P<0.05$ indicated that the difference was statistically significant.

Results

General information

Analysis of the general information, including gender, age, BMI, smoking history, drinking history and obesity, did not identify any significant difference between the two groups ($P>0.05$) (**Table 1**).

Comparison of surgical indications between the two groups

Comparing the surgical indications of patients in the two groups, it was found that the hospitalization time, operation time, and ambulation time in the SG were significantly shorter than those in the CG, and the intraoperative blood loss was statistically less in the SG ($P<0.05$) (**Table 2**).

Comparison of the incidence of postoperative delirium between the two groups

Comparison of postoperative delirium rates between the two groups showed that the inci-

Table 1. General information of patients in the two groups

Classification	Study group (n=100)	Control group (n=80)	t/X^2	P
Gender			0.19	0.664
Male	53 (53.00)	45 (56.25)		
Female	47 (47.00)	35 (43.75)		
Age (years old)	69.45±3.31	70.14±3.75	1.37	0.173
BMI (kg/m^2)	20.76±1.23	20.97±1.47	1.10	0.276
Mean course of disease (months)	25.95±1.87	26.35±1.73	1.53	0.129
Smoking			0.05	0.830
Yes	69 (69.00)	54 (67.50)		
No	31 (41.00)	26 (32.50)		
Drinking			0.01	0.911
Yes	54 (54.00)	42 (52.50)		
No	46 (46.00)	38 (37.50)		
Hyperlipidemia			0.01	0.920
Yes	43 (43.00)	35 (43.75)		
No	57 (57.00)	45 (56.25)		
Hypertension			0.70	0.404
Yes	55 (55.00)	39 (48.75)		
No	45 (45.00)	41 (51.25)		
Diabetes mellitus			0.36	0.549
Yes	71 (71.00)	60 (75.00)		
No	29 (29.00)	20 (25.00)		

Table 2. Surgical indications in the two groups

Classification	Study group (n=100)	Control group (n=80)	t	P
Hospitalization time (d)	8.33±2.31	16.47±5.67	14.08	<0.001
Operation time (min)	176.53±25.67	145.56±12.25	10.05	<0.001
Intraoperative blood loss (mL)	101.23±7.55	181.89±6.27	79.07	<0.001
Ambulation time (h)	42.21±6.57	66.34±6.22	25.99	<0.001

Table 3. Incidence of postoperative delirium in the two groups

Classification	Study group (n=100)	Control group (n=80)	X^2	P
One hour after extubation	1	6	-	-
One day after operation	3	4	-	-
Two days after operation	0	2	-	-
Incidence of postoperative delirium	4 (2.50)	12 (15.00)	6.64	0.010

dence of postoperative delirium in the SG was significantly lower than that in the CG (P<0.05). In the SG, delirium occurred in 1 patient one hour after extubation, 3 patients one day after surgery, and none two days after surgery, and the incidence of postoperative delirium was 2.50%. Delirium occurred in 6 patients in the CG one hour after extubation, 4 patients one day after surgery, and 2 patients two days after surgery, with a postoperative delirium incidence of 15.00% (**Table 3**).

Comparison of epinephrine and norepinephrine levels between the two groups

The adrenaline levels of the SG before operation, 3 days after operation, and 14 days after operation were (36.55±4.16) mmol/L, (22.37±4.43) mmol/L, and (20.12±3.29) mmol/L respectively, while those in the CG were (37.02±4.07) mmol/L, (39.27±5.53) mmol/L, and (36.54±3.56) mmol/L, respectively. The levels of norepinephrine in the SG before operation, 3 days after operation and 14

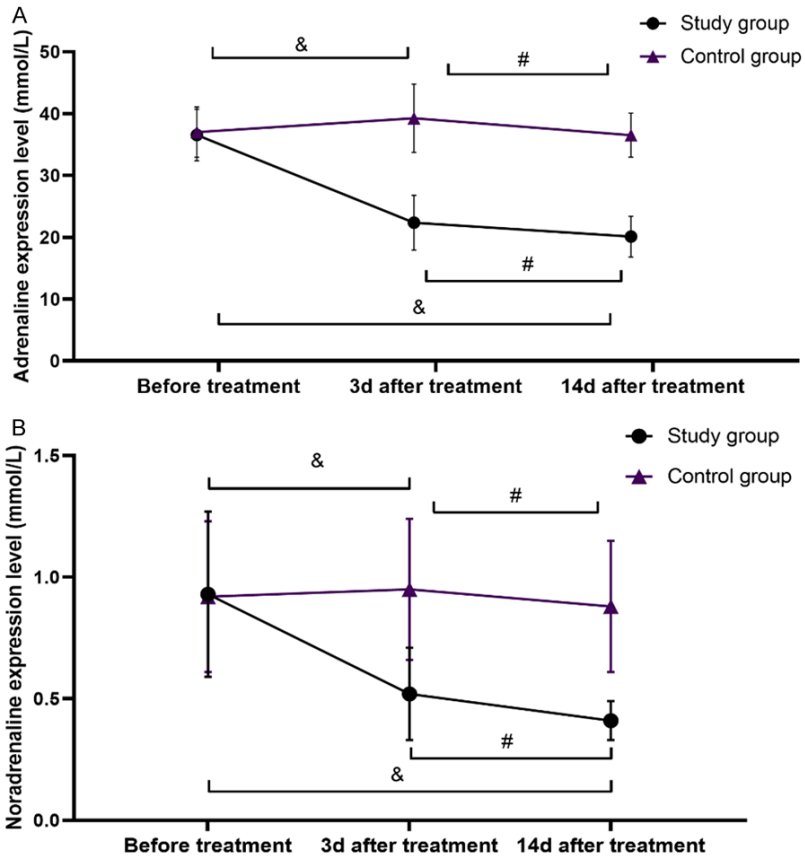

Figure 1. Epinephrine and norepinephrine levels in the two groups. A: Epinephrine levels in two groups: Compared with the epinephrine level before operation, the epinephrine level in the control group decreased significantly 3 days after operation, but was not significantly different from that 14 days after operation. There was significant change in the epinephrine level in the study group, and the epinephrine level in the study group was significantly lower than that in the control group 3 and 14 days after operation (P<0.05). B: Norepinephrine levels in the two groups: Compared with the norepinephrine level before operation, the norepinephrine level reduced markedly in the control group 3 days after operation, but was not significantly different from that 14 days after operation. There was significant change in the norepinephrine level in the study group, and the norepinephrine level in the study group was significantly lower than that in the control group 3 and 14 days after operation (P<0.05). Note: & indicated P<0.05 compared with that before operation, and # indicated P<0.05 compared with that 3 days after operation.

Table 4. Pressure injury level in the two groups

Classification	Study group (n=100)	Control group (n=80)	t	P
Stage 1	2	9	6.75	0.009
Stage 2	0	4	5.11	0.024

days after operation were (0.93±0.34) mmol/L, (0.52±0.19) mmol/L, and (0.41±0.08) mmol/L, respectively while those in the CG were (0.92±0.31) mmol/L, (0.95±0.29) mmol/L, and (0.88±0.27) mmol/L, respectively. The results showed that serum epinephrine and norepinephrine levels were not significantly different between the two groups before surgery. The serum epinephrine and norepinephrine levels in the CG increased a little 3 days after operation (P<0.05), but their levels at 14 days after operation was not significantly different from those before operation (P>0.05). In the SG, the serum epinephrine and norepinephrine levels decreased gradually after 3 and 14 days of treatment (P<0.05). The levels of adrenaline and norepinephrine in the SG were significantly lower than those in the CG at 3 and 14 days after surgery (P<0.05) (**Figure 1**).

Comparison of pressure injury levels between the two groups

Comparing the pressure level of patients in the two groups, it was found that the number of patients with stage 1 and stage 2 pressure injuries in the SG were remarkably less than that in the CG (**Table 4**).

Comparison of neurological function and mental health between the two groups

Neurological function. The NIHSS scores of the SG before and after operation were (73.67±6.23), (38.26±2.55) respectively, while those of the CG were (74.21±5.83), (49.48±3.67) respectively. The NIHSS score of both groups decreased one month after nursing, and the NIHSS score of the SG one month

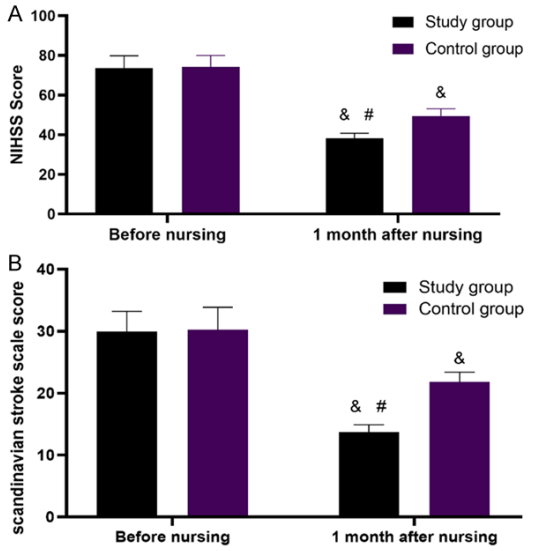

Figure 2. Neurological function in the two groups. A: NIHSS scores in the two groups: The NIHSS score of both groups decreased one month after nursing, and the NIHSS score in the SG was notably lower than that in the CG one month after nursing. B: SSS scores in the two groups: The SSS score of both groups decreased one month after nursing, and the SSS score in the SG was dramatically lower than that in the CG one month after nursing (P<0.05). Note: & indicated P<0.05 compared with that before nursing, and # indicated P<0.05 compared with the CG.

after nursing was significantly lower than that of the CG (P<0.05). The SSS scores of the SG before and after operation were (29.93±3.29), (13.67±1.22) respectively, while those of the CG were (30.21±3.66), (21.82±1.56) respectively. The SSS score of both groups decreased one month after nursing, and the SSS score of the SG one month after nursing was significantly lower than that of the CG (P<0.05) (**Figure 2**).

Anxiety and depression scores. The SAS scores of the SG before and after operation were (75.54±13.21), (35.34±5.67) respectively, while those of the CG were (75.23±14.11), (47.25±6.43) respectively. The SAS score of both groups decreased one month after nursing, and the SAS score of the SG was significantly lower than that of the CG (P<0.05). The SDS scores of the SG before and after operation were (65.42±10.45), (41.56±5.87) respectively, while those of the CG were (65.14±10.78), (53.47±7.37) respectively. The SDS score of both groups decreased one month after nursing, and the SDS score of the SG was significantly lower than that of the CG (P<0.05) (**Figure 3**).

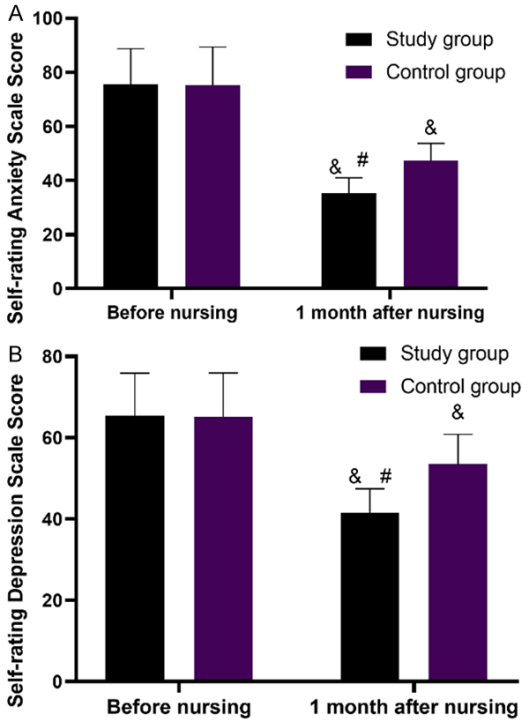

Figure 3. Anxiety and depression scores of patients in the two groups. A: SAS scores of patients in the two groups: The SAS score of the two groups decreased after nursing, and the SAS score in the SG was statistically lower than that in the CG (P<0.05). B: SDS scores of patients in the two groups: The SDS score of both groups decreased after nursing, and the SDS score in the SG was markedly lower than that in the CG (P<0.05). Note: & indicated P<0.05 compared with that before nursing, and # indicated P<0.05 compared with the CG.

Comparison of the total effective rate between the two groups

The comparison of total effective rate revealed that the patients in the SG showed better effectiveness with a total of 60 cases rated as markedly effective, effective in 54 cases and ineffective in 6 cases, with a total effective rate of 95.00%. In the CG, 29 cases were markedly effective, 32 cases were effective and 19 cases were ineffective, with a total effective rate of 76.25%. The total effective rate in the SG was markedly higher than that in the CG (P<0.05) (**Table 5**).

Comparison of satisfaction between the two groups

Patient satisfaction was compared between the two groups. It was found that the satisfaction rate of patients in the SG was significantly higher than that in the CG (P<0.05) (**Table 6**).

Table 5. Total effective rate IN the two groups

Classification	Study group (n=100)	Control group (n=80)	X^2	P
Markedly effective	60 (50.00)	31 (38.75)	-	-
Effective	32 (45.00)	32 (40.00)	-	-
Ineffective	8 (5.00)	17 (21.25)	-	-
Total effective rate (%)	92 (92.00)	63 (78.75)	6.91	0.009

Table 6. Satisfaction of patients in the two groups

Classification	Study group (n=100)	Control group (n=80)	X^2	P
Satisfied	69 (69.00)	35 (43.75)	-	-
Basically satisfied	28 (28.00)	27 (33.75)	-	-
Dissatisfied	3 (3.00)	18 (22.50)	-	-
Total satisfaction (%)	97 (97.00)	62 (77.50)	16.40	<0.001

Discussion

Elderly patients are more susceptible to delirium, a mental illness that is common in clinical treatment after spinal surgery. This issue leads to poor recovery of patients and longer hospitalization, which is a clinical challenge for medical staff [22, 23]. Therefore, the nursing of patients is paramount.

Delirium is considered to be "acute brain failure", a multifactorial syndrome similar to acute heart failure, which is closely associated with brain function and may lead to permanent cognitive decline, eventually leading to dementia [24]. Although it is known that this disease is related to the nervous system, the existing research on its pathophysiology is still incomplete [25]. In this study, the investigation on the incidence of postoperative delirium found that patients who used predictive nursing had a lower incidence. As mentioned earlier, delirium is closely related to brain function, so it needs to be studied in combination with neurological function and depression and anxiety scores. The results showed that patients who received predictive nursing had lower NIHSS and SSS scores, suggesting faster recovery of neurological function with less associated impact under this nursing mode. We also tested patients' levels of epinephrine and norepinephrine, and their anxiety and depression scores. It was found that patients who received predictive nursing had lower norepinephrine and epinephrine levels and SAS and SDS scores. Epinephrine and norepinephrine are closely related to depression and anxiety [26]. Taken together, it proved that patients who received predictive nursing showed less depression and anxiety. In predictive nursing, medical staff studied the data of patients in detail, understood their psychological state, and appeased their negative emotions such as anxiety and fear through communication, leading to less depression and better neurological recovery of patients. According to these results, the reduced incidence of delirium was due to the better recovery of nerve function in the brain and the better cognitive recovery.

Delirium often delays the recovery of patients, as patients with delirium need to stay longer in the intensive care unit (ICU), require more time for mechanical ventilation, with increased length of hospital stay [27]. Combined with the various surgical indications of patients in this experiment, the hospital stay of patients using predictive nursing was indeed shorter, and the series of indicators such as operation time and intraoperative blood loss were also better, confirming the above views. Meanwhile, the study found that the SG had fewer patients with stage 1 and stage 2 pressure injuries than the CG, with a higher total effective rate. It suggested that under predictive nursing, the patient's neurological function recovered better, the anxiety and depression caused by the surgery were reduced, and the probability of postoperative delirium was also lower, so the patient recovered better. The reason behind it may be that, the patients' confidence increased after predictive nursing, and they cooperated more with the medical staff in the operation and subsequent care, and followed the instructions of the medical staff. As a result, the risk of delirium was reduced and the injured area recovered better after surgery. Unfortunately, there is no specific observation and summary of patients' compliance in this study, so the effect of predictive nursing on patients' delirium and recovery can only be discussed through other data. At the same time, we regret that we have not been able to further explore the pathological mechanism behind delirium. In future research, we will pay attention to the patients' intraoperative

compliance while further exploring the pathophysiological mechanism of delirium, in order to better design treatment and nursing methods for delirium.

Conclusion

To sum up, predictive nursing can reduce the incidence of postoperative delirium by reducing anxiety and depression and restoring nerve function in patients after spinal surgery, so that patients can recover better after spinal surgery.

Disclosure of conflict of interest

None.

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