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Analysis of the effect of Ivor-Lewis esophagectomy and McKeown esophagectomy on perioperative anxiety and depression in patients with esophageal cancer

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To compare the effects of Ivor-Lewis esophagectomy and McKeown esophagectomy on perioperative anxiety and depression in patients with esophageal cancer. Sixty-three patients with stage I-III middle and lower esophageal carcinoma from June 2021 to December 2022 were randomly divided into observation group (n = 32) treated with laparoscopic Ivor-Lewis esophagectomy and control group (n = 31) treated with laparoscopic McKeown esophagectomy. Self-Rating Depression Scale (SDS) and Self-Rating Anxiety Scale (SAS) were measured on the second day of admission and the fifth day after surgery to assess the presence of depression and anxiety. The preoperative and postoperative clinical data of both groups were compared, and multivariate analysis was used to identify risk factors associated with depression and anxiety in patients with esophageal cancer. There was no significant difference in SDS and SAS standard scores between the observation group and the control group ($P > 0.05$). The postoperative SDS and SAS scores in the control group were significantly higher than those before and after operation in the observation group ($P < 0.01$). According to univariate analysis, patients with TNM stage III, tumor diameter greater than 3 cm, postoperative complications, radical McKeown esophagectomy, and C-reactive protein levels above 10 mg/L had a higher incidence of depression and anxiety ($P < 0.05$). Multivariate logistic analysis showed that TNM stage III (depression: OR 1.683, 95 CI 1.429–1.861; Anxiety: OR 1.739, 95 CI 1.516–1.902), postoperative complications (depression: OR 2.345, 95 CI 1.435–3.891; Anxiety: OR 1.872, 95 CI 1.372–3.471), surgical approach (depression: OR 1.609, 95 CI 1.502–3.193; Anxiety: OR 1.658, 95 CI 1.469–2.059), and C-reactive protein (depression: OR 2.260, 95 CI 1.157–4.059; Anxiety: OR 0.373, 95 CI 0.253–0.976) were all independent factors for depression and anxiety in patients after esophageal cancer surgery ($P < 0.05$). The Ivor-Lewis esophagectomy has the advantages of fewer complications and low inflammatory response, which can help alleviate anxiety and depression and improve patients' quality of life and prognosis. *European Journal of Cancer Prevention* **33: 200–207 Copyright © 2023 The Author(s). Published by Wolters Kluwer Health, Inc.**

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Introduction

Esophageal cancer is a common malignant tumor of digestive tract. In recent years, the mortality of esophageal cancer has shown a significant increase. Worldwide, its incidence ranks eighth, and its mortality ranks sixth (Sung *et al*., 2021). Esophageal cancer has a poor prognosis, with a 5-year survival rate of approximately 20% (Reichenbach *et al*., 2019). Currently, surgical treatment is the most effective way to treat esophageal cancer and can significantly improve the prognosis of patients with early and mid-stage esophageal cancer. Surgical methods for treating esophageal cancer are classified into traditional thoracotomy and thoracoscopic minimally invasive esophagectomy. At present, the commonly used minimally invasive surgical methods in clinical practice are laparoscopic cervical anastomosis (McKeown) and intrathoracic anastomosis (Ivor-Lewis). The McKeown esophagectomy, which is relatively easier to perform on and has lower medical costs, is frequently used in clinical practice (Junttila *et al*., 2022).

The new medical model proposes that the development, progression, and outcome of diseases result from a combination of biological, psychological, and social factors. Psychosocial factors are also considered to play a very important role in the pathogenesis of malignant tumors. Anxiety and depression, being negative emotions, are the most prevalent mental and psychological issues experienced by cancer patients and can significantly impact the

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physical and mental well-being of patients (Deshields *et al.*, 2022). In recent years, as the medical model has evolved, more and more medical researchers have begun to investigate the influence of psychosocial factors on the development, progression, and prognosis of malignant tumors. Major depression, minor depression, and anxiety have been shown to occur in 15%, 20%, and 10% of patients receiving cancer therapy (Pitman *et al.*, 2018), respectively. Depression and anxiety can negatively impact the treatment, quality of life, and prognosis of cancer patients, whereas maintaining a healthy psychosocial status can significantly improve treatment compliance and patient prognosis. Depression and anxiety are also common psycho-psychological disorders in patients with esophageal cancer and may be underestimated. High morbidity, mortality and complication rates make patients with this disease particularly prone to emotional distress and mental illness (Housman *et al.*, 2021). Anxiety and depression not only cause physical and digestive damage to patients but also have significant mental and psychological effects on them. Depression has been found to be a major risk factor affecting the quality of life of patients with early esophageal cancer, and patients with depression generally have a worse quality of life compared with patients without depression (Wu *et al.*, 2020). Therefore, integrating psychosocial therapy into the comprehensive treatment of esophageal cancer, in conjunction with conventional treatment, can not only enhance the effectiveness of conventional treatment but also prolong patient survival time and improve their quality of life.

The influence of psychosocial factors on the occurrence, development, and prognosis of esophageal cancer has drawn increasing attention in the medical community. In recent years, there has been a growing body of research on anxiety and depression, two mood disorders that are the most prevalent psychological problems experienced by cancer patients (Housman *et al.*, 2021). Many studies have shown that depression and anxiety can affect the prognosis and long-term survival of cancer patients, and good psychological status plays an important role in the diagnosis and treatment of cancer as a psychosomatic disease. Anxiety and depression not only cause physical and digestive damage to patients but also have significant mental and psychological effects on them (Hellstadius *et al.*, 2015). In this study, we administered a self-rating depression scale (SDS) and self-rating anxiety scale (SAS) to measure the effect of radical Ivor-Lewis esophagectomy of esophageal cancer and radical McKeown esophagectomy on anxiety and depression in patients with esophageal cancer. Univariate and multivariate regression analyses were performed to identify factors influencing anxiety and depression, providing a foundation for individualized and precise treatment of esophageal cancer.

Information and methods

Clinic general data

The clinical data of 63 patients with middle and lower thoracic esophageal carcinoma who underwent surgery in our hospital from June 2021 to December 2022 were enrolled and randomly divided into observation group (n = 32) treated with laparoscopic Ivor-Lewis esophagectomy and control group (n = 31) treated with laparoscopic McKeown esophagectomy. Inclusion criteria: 1) Having met the diagnostic criteria of esophageal cancer; 2) Postoperative pathological examination showed squamous cell carcinoma; 3) The lesion was located in the middle and lower thoracic segment; 4) Preoperative clinical stage was cT1NxM0-cT3NxM0; TNM stage I-III; 5) Preoperative examination showed no enlarged lymph nodes in the neck; 6) All cases received bilateral recurrent laryngeal nerve chain lymph node dissection + total thoracic lymph node dissection + upper abdominal lymph node dissection; 7) Digestive tract reconstruction was performed using tubular gastric replacement with esophagogastric end-to-side mechanical anastomosis. Exclusion criteria: 1) Distant metastasis; 2) Concurrence with severe heart, brain, liver and kidney disease; 3) Expected survival time of less than 6 months; 4) Related treatment received before admission; 5) There were no significant differences in the general clinical data between the two groups of patients who received palliative surgery or were converted to traditional open surgery during the operation ($P > 0.05$).

Surgical approach

Patients in both groups underwent double-lumen endotracheal intubation under general anesthesia, and patients in the observation group underwent Ivor-Lewis esophagectomy: The patient was positioned supine and a 10 mm incision was made in the center of the abdomen to establish a port. A laparoscope was inserted to free the stomach and dissect abdominal lymph nodes. The esophagus was divided at the cardia and the gastric body was retracted. The diameter was freed and cut to a length of less than 3 cm along the greater curvature. The tubular stomach was about 30-32 cm long, and a jejunal feeding tube was inserted. The tubular stomach was then placed within the abdominal cavity and the incision was sutured if no active bleeding was present. The patient was then repositioned in the left lateral decubitus position, and a thoracoscope was inserted through the 7th intercostal space of the right midaxillary line. The esophagus was dissociated and nearby lymph nodes were dissected. The main operation hole was entered by the purse-string forceps, and the needle was inserted 5 cm away from the tumor's edge at the closed segment of the esophagus. The esophagus was divided, the suture was tightened, and the tumor was removed. A circular stapler was placed through the fundus of the stomach to butt the gastroesophageal end for anastomosis. The jejunal tube was removed after the completion of the anastomosis, and the gastric tube was placed. The anastomosis was sutured, the thoracic drainage tube was indwelled, and the incision was sutured.

Table 1 Comparison of general clinical data between the two groups of patients with esophageal cancer

	Sex			Lesion location		TNM stage		
Group	Male	Female	Age	ME	LE	I stage	II stage	III stage
Ivor-Lewis	18	14	66.32 ± 7.02	20	12	4	15	13
McKeown	19	12	66.10 ± 9.08	18	13	5	16	10
t or χ^2	0.165		0.732	0.129		0.415		
P	0.685		0.466	0.719		0.813		

LE, lower esophageal; ME, median esophagus.

Patients in the control group underwent McKeown esophagectomy: The patient was first positioned in the left lateral decubitus position, and laparoscopic techniques were used to free the esophagus and dissect nearby lymph nodes. The patient was then repositioned in the supine position, and laparoscopic techniques were used to free the stomach and dissect abdominal lymph nodes. At the same time, a neck operation was performed by making a 5 cm incision at the anterior edge of the left sternocleidomastoid muscle to expose the cervical esophagus. The stomach and esophagus were pulled out to create a tubular stomach, and the thoracic esophagus was partially removed. Mechanical suture was performed on the left side of the neck. The operation technique was essentially the same as that of the observation group, with the exception that the anastomotic site differed.

Depression and anxiety test

Patients who had completed junior high school or above were confirmed to have a full understanding of the scale, and were then instructed to personally fill out the questionnaires. Patients with a lower level of education were provided with an explanation of the scale by trained investigators, but were also instructed to personally fill out the questionnaires. At the time of the self-assessment, the family members were asked to withdraw themselves and the scale was collected on-site. The Self-Rating Depression Scale (SDS) and Self-Rating Anxiety Scale (SAS), developed by Zung, were utilized as evaluation scales for depression and anxiety, respectively. All patients completed self-assessment tests on days 1 and 7 following their admission diagnosis, with the mean value of the two tests used for analysis. The patients were asked to score 20 items on the scale based on their emotions, and then to sum up the scores to obtain a total raw score. This raw score was then transformed using the following formula: The total raw score was transformed using the following formula: Y = ln (1.25X), where Y represents the standard score, X represents the total raw score, and Y represents the integer part of 1.25 times the total raw score. The standard scores for depression and anxiety in this patient group were compared to the normative data for the SDS and SAS in China, respectively.

Statistical methods

The study data were statistically analyzed using SPSS 21.0. Data are presented as mean ± SD. The differences between groups were compared with the t test. Qualitative data were compared between the two groups using the χ^2 test. Multivariate analysis was performed using unconditional logistic regression analysis. The significance level $\alpha = 0.05$.

Results

Comparison of clinical data between Ivor-Lewis esophagectomy and McKeown esophagectomy groups

This study included 63 cases that were divided into two groups based on the surgical method used: The Minimally Invasive McKeown Esophagectomy group and the Minimally Invasive Ivor-Lewis Esophagectomy group. The clinical data of the two groups were compared, and the results showed that there were no statistically significant differences in gender, age, tumor location, and tumor stage between the two groups ($P > 0.05$, Table 1).

Comparison of surgical complications between Ivor-Lewis and McKeown

The incidence of postoperative complications in 32 patients with middle and lower esophageal carcinoma who underwent radical Ivor-Lewis esophagectomy and 31 patients who underwent radical McKeown esophagectomy was analyzed. The analysis results showed that: there were no significant differences in the incidence of postoperative anastomotic leakage, recurrent laryngeal nerve injury and arrhythmia between the Ivor-Lewis esophagectomy group and the McKeown esophagectomy group; however, the incidence of total postoperative complications in the Ivor-Lewis esophagectomy group was significantly lower than that in the McKeown esophagectomy group, and the difference was statistically significant ($P < 0.05$, Table 2).

Preoperative and postoperative mean scale value of depression and anxiety were compared between the Ivor-Lewis esophagectomy and McKeown esophagectomy groups

Based on the Chinese norm, a standard score of 50 points is the diagnostic cutoff value for depression and anxiety. A standard score ≥50 points indicates the

presence of symptoms of anxiety and depression. The evaluation and statistical results of patients in the two groups showed: there were no significant difference in the mean preoperative SDS and SAS standard scores between the radical Ivor-Lewis esophagectomy group and the radical McKeown esophagectomy group ($P > 0.05$). In the group of patients who underwent radical Ivor-Lewis esophagectomy, the mean postoperative SDS standard score was 43.26 ± 7.49, and the mean SAS standard score was 42.16 ± 5.36. These scores were not significantly different from the preoperative SDS standard score of 41.93 ± 5.07 and SAS standard score of 42.16 ± 5.36, respectively ($P > 0.05$). The postoperative SDS (49.76 ± 8.34) and SAS (47.24 ± 5.60) standard scores in the radical McKeown esophagectomy group were significantly higher than those before surgery ($P < 0.05$), and there were significant differences compared with the postoperative SDS (43.26 ± 7.49) and SAS (42.16 ± 5.36) standard scores in the Ivor-Lewis esophagectomy group ($P < 0.05$, Table 3).

Univariate analysis of clinical data of patients with esophageal cancer complicated with depression and anxiety symptoms

Sixty-three patients with esophageal cancer were examined by SDS and SAS scales, 27 patients were diagnosed with depressive symptoms, and 24 patients were diagnosed with anxiety symptoms. Univariate analysis of the clinical data of patients with depression and anxiety showed that: the symptoms of depression and anxiety in patients with esophageal cancer were correlated with tumor size, TNM stage, pain level, postoperative complications and surgical methods. Patients with TNM stage III, tumor diameter greater than 3 cm, postoperative complications, radical McKeown esophagectomy, and C-reactive protein levels above 10 mg/L had a higher incidence of depression and anxiety ($P < 0.05$, Table 4).

Multivariate analysis of the correlation between depression and anxiety symptoms and clinical characteristics of patients with esophageal cancer

Logistic multivariate regression analysis suggested: TNM stage III (depression: OR 1.683; Anxiety: OR 1.739), postoperative complications (depression: OR 2.345; Anxiety: OR 1.872), surgical methods (depression: OR 1.609; Anxiety: OR 1.658), and C-reactive protein (depression: OR 2.260; Anxiety: OR 0.373) were all independent factors for depression and anxiety in patients after esophageal cancer surgery ($P < 0.05$). Among them, patients with postoperative patients with TNM stage III, presence of postoperative complications, McKeown esophagectomy (compared with Ivor-Lewis esophagectomy), and C-reactive protein >10 mg/L had a higher incidence of depression and anxiety (Table 5).

Discussion

Systematic lymph node dissection via the right thoracic approach is currently a relatively recognized surgical approach for thoracic surgeons, whereas the Ivor-Lewis esophagectomy and the McKeown esophagectomy are typical surgical methods. It is believed by some scholars that Ivor-Lewis esophagectomy is advantageous in terms of exposing important regional lymph nodes such as the upper mediastinum and the left and right recurrent laryngeal nerves. Additionally, it can facilitate the complete dissection of regional lymph nodes or an extended dissection, making it the preferred surgical method for the treatment of middle and lower thoracic esophageal cancer (Unttila *et al.*, 2022). McKeown esophagectomy offers the advantage of performing thoracic operation first, allowing for exploration of the condition of thoracic esophageal cancer. If tumor resection is difficult, palliative treatment can be considered, thus avoiding unnecessary abdominal surgical procedures. This procedure allows three-field lymph node dissection and is the preferred surgical approach

Table 2 The operative complications were compared between the two groups

	N	PI	AL	RLNI	CA	Total Numbers
Ivor-Lewis	32	1 (3.13%)	1 (3.13%)	0 (0.00%)	1 (3.13%)	3
McKeown	31	3 (9.68%)	2 (6.45%)	1 (3.23%)	5 (12.9%)	11
χ^2		1.137	0.384	1.049	3.091	6.210
P value		0.286	0.535	0.306	0.079	0.013

AL, anastomotic leakage; CA, cardiac arrhythmia; PI, pulmonary infection; RLNI, recurrent laryngeal nerve injury.

Table 3 Preoperative and postoperative evaluation results in patients with depression and anxiety

	SDS			SAS		
	Preoperative	Postoperative	*P* value	Preoperative	Postoperative	*P* value
Ivor-Lewis	41.93 ± 5.07	43.26 ± 7.49	0.269	39.3 ± 4.71	42.16 ± 5.36	0.072
McKeown	41.89 ± 5.66	49.76 ± 8.34	0.031	38.67 ± 4.62	47.24 ± 5.60	0.004
P value	0.873	0.017	0.952		0.026	

SAS, Self-Rating Anxiety Scale; SDS, Self-Rating Depression Scale.

for the treatment of middle and upper thoracic esophageal cancer (Eddahchouri *et al*., 2022). Compared to conventional surgery, minimally invasive Ivor-Lewis esophagectomy for esophageal cancer offers the benefits of reduced trauma, lower pain, fewer complications, and faster postoperative recovery, and has demonstrated a safe and dependable short-term surgical outcome (Brown *et al*., 2018).

Table 4 Univariate analysis of clinical characteristics of depression and anxiety reduction after opreation

	N	PWD	*P* value	PWA	*P* value
Sex					
Male	37	16	0.867	14	0.96
Female	26	11		10	
Age (years)					
≤65	21	8	0.589	9	0.492
≥65	42	19		15	
Course (months)					
≤1	19	5	0.081	4	0.067
>1	44	22		20	
Residence					
ME	38	20	0.696	19	0.272
LE	15	7		5	
Medical insurance					
Yes	63	27	--	24	--
No	0	0		0	
Fasting blood glucose (mmol/L)					
≥ 10	10	4	0.842	3	0.565
< 10	53	23		21	
TNM Stage					
I-II	40	13	0.028	11	0.022
III	23	14		13	
Tumor size (cm)					
≤ 3	24	5	0.006	5	0.027
> 3	39	22		19	
Intraoperatve blood loss (ml)					
<200 mL	52	23	0.632	21	0.416
≥200 mL	11	4		3	
Pain rating					
<II	46	19	0.682	18	0.781
≥II	17	8		6	
Postoperative complication					
With	12	9	0.012	7	0.014
Without	51	18		17	
Insomnia					
With	14	8	0.109	9	0.221
Without	49	19		15	
Operation methods					
Ivor-Lewis	32	9	0.016	5	0.000
McKeown	31	18		19	
BMI					
18.5–23.9	50	23	0.560	21	0.365
≥24.0	11	4		3	
CRP (mg/L)					
0–10	25	6	0.014	4	0.030
>10	38	21		20	

CRP, C-reactive protein; PWA, patients with anxiety; PWD, patients with depression.

Currently, the management of esophageal cancer involves a multidisciplinary approach, which includes a comprehensive diagnostic and treatment model that provides timely standardized and precise individualized plans for patients. This approach aims to maximize the inhibition of tumor growth, extend the survival time of patients, and improve their quality of life. The prognosis of esophageal cancer is relatively poor and is closely related to several factors such as tumor invasion, metastasis, and psychological factors (Raymond *et al*., 2016). Among these, psycho-psychological disorders, particularly anxiety and depression, are most prominent. Studies suggest that cancer patients have a relatively poor mental health status, with depression and anxiety occurring twice as frequently as in normal subjects (Zhu *et al*., 2019). Anxiety and depression are common comorbidities in patients with esophageal cancer, which can lead to decreased adherence to clinical treatment and negatively impact patients' quality of life and overall prognosis (Sabra *et al*., 2020). Revised: Currently, there is limited research on the specific extent of perioperative anxiety and depression and the factors that affect it in different radical operations for esophageal cancer, particularly with Ivor-Lewis and McKeown esophagectomy. Hence, reducing the occurrence of depression and anxiety in patients with esophageal cancer and promptly diagnosing the degree of depression and anxiety in patients after esophageal cancer surgery is crucial. It is also a new area of focus in the present comprehensive treatment of esophageal cancer.

Self-rating anxiety and depression scale is widely used in clinical treatment and research, with high effectiveness, reliability, simplicity and other characteristics, its content involves emotional experience and emotional related somatic symptoms. Our team used self-rating anxiety scale and self-rating depression scale to compare the difference in depression and anxiety between Ivor-Lewis

Table 5 Logistic regression analysis of the clinical features in esophageal cancer patients with depression and anxiety

Variables	β value	SE	Wald χ^2 value	OR value	95% CI	*P* value
Depression						
TNM Stage (III)	0.693	0.182	10.038	1.683	1.429–1.861	0.017
Tumor size (>3 cm)	0.753	0.451	3.409	2.272	0.936–4.795	0.082
Postoperative complication	1.016	0.331	9.796	2.345	1.435–3.891	0.000
surgical methods	0.616	0.197	10.193	1.609	1.502–3.193	0.000
CRP (>10 mg/L)	0.791	0.394	4.586	2.260	1.157–4.059	0.027
Anxiety						
TNM Stage (III)	0.596	0.195	10.118	1.739	1.516–1.902	0.014
Tumor size (>3 cm)	0.635	0.506	3.728	2.129	1.086–4.547	0.065
Postoperative complication	0.683	0.221	12.798	1.872	1.372–3.471	0.000
surgical methods	0.595	0.181	11.387	1.658	1.469–2.059	0.013
CRP (>10 mg/L)	0.961	0.493	4.495	0.373	0.253–0.976	0.026

CRP, C-reactive protein.

and McKeown esophagectomy in perioperative patients with esophageal cancer, and then analyzed the related factors causing depression and anxiety in patients. Results showed: Compared with McKeown esophagectomy, Ivor-Lewis esophagectomy showed a relatively lower incidence of postoperative complications such as anastomotic leakage, pulmonary infection, anastomotic stricture, recurrent laryngeal nerve palsy, but there were no statistical differences in subgroup statistics, which may be related to the small sample size. However, the overall complication rate was significantly lower in the Ivor-Lewis group compared to the McKeown group, and the difference was statistically significant. This is thought to be due to the larger number and extent of dissected lymph nodes in the minimally invasive McKeown esophagectomy (Ma *et al*., 2014). In terms of perioperative depression and anxiety in patients with esophageal cancer, there were no significant differences in preoperative depression and anxiety scores between the Ivor-Lewis esophagectomy group and the McKeown esophagectomy group. There was no significant difference between the preoperative and postoperative standard mean scores of depression and anxiety in the Ivor-Lewis esophagectomy group. However, in the McKeown esophagectomy group, the standard mean scores of depression and anxiety were significantly higher after surgery, with a statistically significant difference compared to the preoperative scores. Compared to the Ivor-Lewis esophagectomy group, the McKeown esophagectomy group had significantly higher postoperative depression and anxiety scores, which were also significantly different from the mean preoperative standard score of depression and anxiety in patients. In order to investigate the influencing factors of perioperative depression and anxiety in patients with esophageal cancer, 63 patients were examined and analyzed by self-rating depression and anxiety scale. The results showed that: of the 63 patients, 27 patients had concurrent depressive symptoms and 24 patients had anxiety, accounting for 42.86% and 38.1%, respectively. A prospective cohort study by Hellstadius *et al*. (Hellstadius *et al*., 2016) included 106 patients with esophageal cancer and measured the prevalence of anxiety and depression in patients after diagnosis of esophageal cancer and before surgery; ot found that 34% had anxiety and 33% had depression. In the same disease, why is the incidence of depression and anxiety measured in this study higher than in the study by Hellstadius et al? Our team analyzed the results and found that the higher postoperative depression and anxiety scores in the McKeown esophagectomy group might be attributed to the exclusion of patients with early-stage esophageal cancer from the study criteria. Additionally, all the enrolled patients underwent radical surgery, which suggests that the presence of depression and anxiety symptoms in patients with esophageal cancer may be related to the stage and type of surgery. Based on the analysis of the clinical data of patients with esophageal cancer complicated with depression and anxiety by univariate analysis, the results showed that the occurrence of perioperative depression and anxiety in patients with esophageal cancer was associated with TNM stage, tumor size, postoperative complications, surgical methods and C-reactive protein. Patients with TNM stage III disease, tumors larger than 3 cm, presence of postoperative complications, McKeown esophagectomy, and C-reactive protein greater than 10 mg/L had a higher incidence of depression and anxiety. McKeown esophagectomy was associated with significantly higher rates of depression and anxiety than the Ivor-Lewis esophagectomy group, and studies have shown that Ivor-Lewis can reduce recurrent laryngeal nerve injury, shorten hospital stay and reduce bleeding (van Workum *et al*., 2017; Jung *et al*., 2020), suggesting that greater surgical trauma and postoperative complications can lead to anxiety and depressive symptoms in patients. Logistic multivariate regression analysis showed that TNM stage III, presence of postoperative complications, McKeown esophagectomy and C-reactive protein greater than 10 mg/L were independent factors affecting depression and anxiety in patients after radical resection of esophageal cancer. Based on these results, it is crucial to closely monitor the psychological well-being of patients while treating esophageal cancer. Early detection of abnormal psychological status and behavior in patients, and timely intervention with effective psychological support can correct and improve the psychological status of patients. The modern model of 'bio-psycho-social' medicine (Song *et al*., 2010) emphasizes the importance of addressing the biological, psychological, and social factors that contribute to the development and treatment of esophageal cancer. Therefore, a treatment model that solely focuses on biological factors may not align with the goals of diagnosing and treating esophageal cancer. Greater attention should be paid to the mental health of cancer patients to help them maintain a positive outlook, ultimately leading to better prognosis, quality of life, and survival rates.

Patients with esophageal cancer who experience more complications after surgery may suffer from increased fatigue, weakness, and negative emotions, which can further impact their overall health and well-being (Vulser *et al*., 2016). This can be due to factors such as anemia and psychological distress, which can lead to inadequate oxygen supply to the brain (Slavich and Irwin, 2014). Psychological stress can trigger the production of small messenger molecules and pro-inflammatory cytokines, such as interleukin 1β (IL-1β), interleukin 6 (IL-6), and tumor necrosis factor-α (TNF-α), leading to increased inflammatory responses in the body. These cytokines can act on the brain, inducing depression-like states and exacerbating psychological disorders in patients (Slavich and Irwin, 2014). Postoperative complications of esophageal cancer such as pulmonary infection and anastomotic leakage can

cause inflammatory reactions and exacerbate anxiety and depression (van Workum *et al*., 2020). Relatively low rates of anxiety and depression in patients following Ivor-Lewis esophagectomy have been associated with relatively low rates of pulmonary complications, recurrent laryngeal nerve injury, anastomotic leakage, arrhythmias, and relatively short hospital stays (Barreto and Posner, 2010; Ajani *et al*., 2011; Jezerskyte *et al*., 2020; Sabra *et al*., 2020; Slaman *et al*., 2022). In the clinical treatment of esophageal cancer, we should pay attention to the psychological status of patients, minimize the psychological barriers caused by surgical trauma, strictly grasp the surgical indications, and strengthen doctor-patient communication and family-patient communication. Most of the patients with a total score of more than 50 points on the self-rating depression scale and self-rating anxiety scale had personality deviations, manifested as stubbornness, stereotype, irritability and suspiciousness, which seriously affected the treatment outcome and quality of life of patients with esophageal cancer. To address this issue, it is important to increase oncologists' awareness and understanding of the negative impact of depression and anxiety on patients. Routine screening for depression and anxiety using the Depression and Anxiety Scale should be implemented, and patients identified as at risk should be offered psychological counseling. When necessary, referral to a psychiatrist should be made, and symptomatic treatment of depression and anxiety should be provided. Based on these recommendations, we can improve the quality of life for patients with esophageal cancer and promote better outcomes. Various psychological interventions, including cognitive-behavioral therapy, dynamic psychotherapy, biofeedback therapy, and relaxation therapy, can be used to help patients establish healthy disease thinking, improve their mood, and adjust their behaviors. These interventions can also enhance doctor-patient communication and promote physical and mental self-regulation in patients, which can greatly support the treatment of the primary disease by addressing depression and anxiety (Zhu *et al*., 2017). Pharmacological treatments are as follows, and current psychotropic antidepressant and anxiolytic drugs mainly include beta-adrenergic blockers, monooxygenase inhibitors, benzodiazepines, selective serotonin reuptake inhibitors, and other drugs (e.g. buspirone tablets and venlafaxine) (Fang *et al*., 2019). Psychiatrists are advised to give individualized comprehensive treatment after drug intervention (Cohen *et al*., 2016).

In summary, esophageal cancer patients are complicated with anxiety and depression in the perioperative period, which seriously affects the treatment, quality of life and prognosis of patients. TNM greater than stage III, severe postoperative complications, McKeown esophagectomy, and C-reactive protein greater than 10 mg/L are independent factors leading to depression and anxiety in esophageal cancer patients. Therefore, it is important to actively and effectively manage and control depression and anxiety in patients with esophageal cancer, especially in those with risk factors, in order to improve their quality of life and prognosis.

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Conflicts of interest

There are no conflicts of interest.

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