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Original Article

Evaluation of effects of nutritional risk assessment and enteral and parenteral nutritional interventions after esophageal cancer surgery

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Abstract: Objective: Our aim was to assess effects of postoperative nutritional risk and enteral and parenteral nutritional interventions after esophageal cancer surgery (ECS). Methods: A total of 98 patients with esophageal cancer treated in our hospital from October 2015 to October 2017 were selected and divided into observation group (n=49) and control group (n=49) by random number table method. Nutritional risk was assessed by Nutritional Risk Screening 2002. The control group used routine parenteral nutritional intervention while observation group used enteral and parenteral nutritional interventions. Nutrition status, immune function, complication, Karnofsky performance status (KPS) score, hospitalization condition, and nutritional risk assessment results were compared. Results: The observation group had significantly higher nutrition status and immune function than control group (both P<0.05). The observation group had significantly higher KPS scores after 4, 8 and 12 days of intervention than control group (all P<0.05). Observation group also had a significantly lower incidence of complications than control group (P=0.0136). The observation group had significantly shorter anus exhaust time and length of stay and a significantly lower cost of hospitalization than control group (all P<0.05). The observation group had significantly lower nutritional risk assessment results than control group (P<0.05). Conclusion: After surgery, there are nutritional risks for esophageal cancer. Routine enteral and parenteral nutritional interventions can significantly elevate nutrition status and decrease incidence of complications. These interventions have definite efficacy and are worthy of clinical application.

Keywords: Esophageal cancer surgery, nutritional risk, enteral and parenteral nutritional intervention, efficacy

Introduction

Esophageal cancer is a clinically common disease and is predominately treated with surgery. Before surgery, patients generally have difficulty in swallowing. Meanwhile, because of tumor consumption and effects of fasting, patients often have a state of negative nitrogen balance or malnutrition. During surgery, malnutrition symptoms are further aggravated, severely affecting recovery and causing various complications. Hence, postoperative nutritional support is a key to elevating the success ratio of surgery. Long-term parenteral nutritional interventions cause atrophy of the gastrointestinal mucous membrane, promote permeability of gastrointestinal tract, impair the barrier function, greatly increase incidence of enterogenic infection, multiple organ dysfunction, and ichoremia. These significantly prolong the treatment period and increase costs of treatment, markedly increasing economic pressure and mental burden. Therefore, it is limited and is poorly accepted by patients [1]. In the study of Lu et al., efficacy of usual care and early enteral nutritional intervention was compared and the value of early enteral nutritional intervention was confirmed [2]. In our study, we compared parenteral nutritional intervention and enteral and parenteral nutritional interventions. Thus, to assess nutritional risks and the efficacy of enteral and parenteral nutritional interventions after surgery for esophageal cancer, we collected data on 98 patients with esophageal cancer treated in Yantai Yuhuangding Hospital, from October 2015 to October 2017. Data are summarized below.

Table 1. Comparison of baseline data

Group	Observation group (n=49)	Control group (n=49)	χ^2/t	P
Gender			0.1667	0.6830
Male	29	27		
Female	20	22		
Average age (years)	63.05±10.29	62.52±9.26	0.2680	0.7893
Average duration (months)	5.52±2.75	6.05±2.86	0.9350	0.3521

Materials and methods

General data

A total of 98 patients with esophageal cancer, treated in Yantai Yuhuangding Hospital from October 2015 to October 2017, were selected and divided into observation group (n=49) and control group (n=49) by random number table method.

Inclusion criteria: (1) All patients were definitely diagnosed by pathological examination and laboratory examination. Right lateral recumbent position was selected for all patients and laparoscopic approach was selected at the fifth intercostal space of the left chest, to explore resectability of the tumor. After incision of diaphragm and mobilization of the stomach, abdominal lymph node dissection was performed. Then, the esophagus was mobilized. Based on the specific location of tumor, a cervical or thoracic mechanical anastomosis was performed. (2) Ages of 18-80 years [3].

Exclusion criteria: (1) The tumor had been distally metastasized; (2) Patients with consciousness disorders, mental disorders, or communication disorders; (3) Patients complicated by other malignant tumors or heart failure; (4) Patients with poor cooperation or compliance; (5) Patients complicated by other digestive system diseases; (6) Patients with surgical contraindication, coagulation disorders, or hematologic diseases.

Methods

Nutritional risk assessment: nutrition was screened in all subjects by Nutritional Risk Screening 2002 including age, score, nutrition status score, and score of severity of the disease. Scores of the 3 items were 0-1 point, 0-3 points, and 0-3 points, respectively. When the total score was ≥3 points, there were nutritional risks. Based on nutritional risk assessment results, a nutritional intervention plan was designed and adjusted [4, 5].

Nutritional intervention measures: (1) Control group: Only received routine parenteral nutritional intervention. At 24 hours after surgery, patients received 24 hour infusion via a central venous catheter, which was composed of microelements, electrolytes, vitamins, glucose, amino acids, and 20% fat milk [6]. (2) Observation group: All patients were given enteral and parenteral nutritional interventions. A nasojejunal feeding tube was intubated. At 12 hours after surgery, 500 mL of glucose saline was infused via the nasojejunal tube. In the absence of gastrointestinal symptoms such as diarrhea and vomiting, enteral nutrition could be given. Fresubin was used as an enteral nutrition preparation at 39-42°C, slowly at first and then quickly, at a small dose first and then at a large dose, at a low concentration first and then at a high concentration. Intervention methods of parenteral nutrition were the same as those of the control group [7, 8].

Evaluation indexes

Nutrition status, immune function, and nutritional risk assessment results were the primary observation indexes. Complication, Karnofsky performance status (KPS) score, and hospitalization condition were secondary observation indexes.

Nutrition status: One month later, 5 mL of venous blood was drawn on an empty stomach. Hemoglobin, plasma albumin, and plasma prealbumin were tested by an automatic blood culture instrument (Bact/ALERT®3D, Ji'nan Xinjing Medical Devices Co., Ltd.).

Immune function: One month later, 5 mL of venous blood was drawn on an empty stomach. IgG, IgA, CD_4^+/CD_8^+, and CD_4^+ were tested by an automatic biochemical analyzer (iChem-520, Shenzhen iCubio Biomedical Technology Co., Ltd.).

Incidence of complications: Incidences of complications of the two groups were statistically treated and calculated.

Table 2. Comparison of nutrition status between the two groups ($\bar{x}$ ± sd)

Group		Observation group (n=49)	Control group (n=49)	t	P
Hemoglobin (mg/dL)	Before intervention	96.25±11.26	95.33±12.03	0.3908	0.6968
	After intervention	135.96±21.87	114.18±18.19	5.3596	0.0000
Plasma albumin (mg/dL)	Before intervention	27.26±6.19	27.22±7.01	0.0299	0.9762
	After intervention	44.76±17.16	31.05±13.06	4.4503	0.0000
Plasma prealbumin (pg/dL)	Before intervention	106.03±9.61	105.11±8.26	0.5082	0.6125
	After intervention	208.15±16.85	135.68±13.28	23.6452	0.0000

Table 3. Comparison of immune function between the two groups ($\bar{x}$ ± sd)

Group		Observation group (n=49)	Control group (n=49)	t	P
IgG (g/L)	Before intervention	8.23±0.54	8.22±0.49	0.0959	0.9237
	After intervention	12.71±1.23	10.57±0.86	9.9811	0.0000
IgA (g/L)	Before intervention	1.62±0.47	1.61±0.55	0.0967	0.9231
	After intervention	2.86±1.17	2.01±0.57	4.5717	0.0000
CD_4^+/CD_8^+ (%)	Before intervention	1.03±0.26	1.04±0.22	0.2055	0.8376
	After intervention	1.86±0.57	1.52±0.11	4.0997	0.0001
CD_4^+ (%)	Before intervention	33.26±5.13	33.28±5.03	0.0194	0.9845
	After intervention	43.76±9.01	38.57±6.51	3.2683	0.0015

KPS score: Physical conditions were scored by KPS score. Total score was 100 points and the level of the score was positively correlated with quality of physical conditions. KPS scores after 4, 8, and 12 days of intervention of the two groups were analyzed [9, 10].

Hospitalization condition: Included anus exhaust time, length of stay, and cost of hospitalization.

Nutritional risk assessment result: Nutritional risk assessment results, before and after nutritional intervention, were compared.

Statistical methods

Data were statistically treated and analyzed by SPSS16.0 statistical software. Numeration data were expressed in percentage (%) and tested by χ^2 while measurement data are expressed as mean ± sd and tested by t-test. When P<0.05, there was a statistically significant difference between the two groups.

Results

General data

In the observation group, there were 20 females and 29 males. Ages ranged from 52-74 years with an average of (63.05±10.29) years. Course of disease was 3-8 months with an average of (5.52±2.75) months. In the control group, there were 22 females and 27 males. Ages ranged from 53-72 years with an average of (62.52±9.26) years. Course of disease was 3-9 months with an average of (6.05±2.86) months. Baseline data of the two groups were comparable (all P>0.05). Details are shown in **Table 1**.

Comparison of nutritional status between the two groups

Before intervention, the two groups had insignificantly different levels of hemoglobin, plasma albumin, and plasma pre-albumin (all P>0.05). After intervention, observation group had significantly higher hemoglobin, plasma albumin, and plasma pre-albumin than the control group (all P<0.05). Details are shown in **Table 2**.

Comparison of immune function between the two groups

Before intervention, the two groups had insignificantly different levels of IgG, IgA, CD_4^+/CD_8^+ and CD_4^+ (all P>0.05). After intervention, observation group had significantly higher IgG, IgA, CD_4^+/CD_8^+ and CD_4^+ than the control group (all P<0.05). Details are shown in **Table 3**.

Table 4. Comparison of incidence of complications between the two groups ($\bar{x}$ ± sd)

Group	Ileacpssion (n)	Pulmonary infection (n)	Intestinal fistula (n)	Incision infection (n)	Complication rate (%)
Observation group (n=49)	0	1	1	0	4.1
Control group (n=49)	2	3	2	3	20.4
χ^2					6.0775
P					0.0136

Table 5. Comparison of KPS score between the two groups ($\bar{x}$ ± sd)

Group	Before intervention (points)	Day 4 (points)	Day 8 (points)	Day 12 (points)
Observation group (n=49)	52.03±6.14	76.28±9.17	85.28±10.17	96.28±12.27
Control group (n=49)	52.11±6.03	63.28±7.66	72.28±8.12	81.28±9.62
t	0.0650	7.6160	6.9924	6.7344
P	0.9483	0.0000	0.0000	0.0000

Note: KPS, Karnofsky performance status.

Table 6. Comparison of hospitalization condition between the two groups ($\bar{x}$ ± s)

Group	Flatus time (h)	Length of stay (d)	Cost of hospitalization (yuan)
Observation group (n=49)	13.28±4.69	12.28±1.68	11,682.17±625.11
Control group (n=49)	59.28±7.11	20.36±3.81	17,828.28±1,028.66
t	37.8044	13.5832	35.7419
P	0.0000	0.0000	0.0000

Table 7. Comparison of nutritional risk assessment result, before and after intervention, between the two groups ($\bar{x}$ ± sd)

Group	Before intervention (point)	After intervention (point)
Observation group (n=49)	3.15±1.26	1.03±0.36
Control group (n=49)	3.14±1.31	1.67±0.67
t	0.0385	5.8901
P	0.9694	0.0000

Comparison of incidence of complications between the two groups

Observation group had a significantly lower incidence of complications than the control group (4.1% vs. 20.4%, P=0.0136). Details are shown in **Table 4**.

Comparison of KPS score between the two groups

Before intervention, the two groups had insignificantly different KPS scores (P>0.05). Observation group had significantly higher KPS scores after 4, 8 and 12 days of intervention than the control group (all P<0.05). Details are shown in **Table 5**.

Comparison of hospitalization condition between the two groups

The observation group had significantly shorter anus exhaust time and length of stay and a significantly lower cost of hospitalization than the control group (all P<0.05). Details are shown in **Table 6**.

Comparison of nutritional risk assessment result before and after intervention between the two groups

Before intervention, the two groups had insignificantly different nutritional risk assessment results (P>0.05). After intervention, observation group had significantly lower nutritional risk assessment results than the control group (P<0.05). Details are shown in **Table 7**. It was clear that enteral and parenteral nutritional intervention effectively decreased nutritional risks in the patients.

Discussion

There are several reasons for nutritional risks after esophageal cancer surgery. Metabolism is too active, the body consumes too much energy, and consequently patients will gradually become thin. Meanwhile, digestive function and mechanical movement of the gastric wall are affected by cancer tissues, decreasing digestion, and utilization of nutrients [11]. In patients with esophageal cancer, intake of nutrient substances is usually affected by symptoms including discomfort, anorexia, and poor appetite. The surgery itself is somewhat of an irritant and the body consumes even more energy. Thus, patients with esophageal cancer have a higher risk of malnutrition than those with other tumors. Malnutrition will impair resistance and prolong postoperative recovery time in these patients [12, 13]. Currently, for patients who have had a surgery for esophageal cancer, nutritional interventions are used to supplement nutrient substances, mainly enteral and parenteral nutritional interventions. There remains a controversy in current clinical practice regarding the right kind of nutritional intervention.

Enteral nutritional intervention can provide various microelements and nutriments required by the body and improve nutrition status of patients. Meanwhile, it has certain nutritional effects on the gastrointestinal tract. It ensures normal functions of the digestive tract, protects the stomach-mucous membrane barrier, and prevents bacterial translocation [14, 15]. It accelerates secretions of gastrointestinal hormone and immune globulin, obviously elevates immunity and improves resistance of the body, and greatly decreases incidence of complications and infection [16]. This nutritional intervention mode is helpful in recovering serum albumin of the body. Nutrient substances are absorbed in the portal system and then transmitted to hepatic tissues to ensure that physiological metabolism is in line with physiological characteristics, having a somewhat positive significance for liver to synthesize protein [17, 18]. Enteral nutritional intervention effectively maintains function of mucous membrane cells and stability and integrity of the structure, preventing enterogenic infection secondary to endotoxin absorption or bacterial translocation from intestine. Ingested nutrient substances stimulate secretion of IgA from intestinal cells. This is helpful for synthesis and release of intestinal hormone and quickens the growth of gastrointestinal mucous membrane, elevating immune function of the body. This effectively promotes recovery of gastrointestinal functions, tremendously reduces incidence of complications, shortens anus exhaust time, and promotes rehabilitation, obtaining the appreciation of clinical staff and patients [19, 20].

As revealed in our study, the observation group had a significantly higher nutrition condition, immune function, KPS score, a significantly lower incidence of complications, and significantly better hospitalization condition than control group (all $P<0.05$). After intervention, the observation group had significantly lower nutritional risk assessment results than the control group ($P<0.05$). In a study by Yi et al., the intervention group had significantly higher nutrition status, a significantly lower incidence of complications (12% vs. 30%, $P=0.0136$), significantly shorter anus exhaust time and length of stay, and a significantly higher KPS score than the control group (all $P<0.05$). These results are similar to our study, confirming the feasibility and availability of enteral and parenteral nutritional interventions in postoperative patients after surgery for esophageal cancer [21].

Early nutritional intervention plays an important role in recovery and prognosis in patients with esophageal cancer. Nutrition assessment is an important task in ensuring surgical efficacy. More studies on nutrition assessment in patients with esophageal cancer should be performed. Conditions of patients with esophageal cancer should be comprehensively analyzed in order to make better targeted nutritional intervention regimens, improve prognosis in the most extent, and elevate quality of life in patients with esophageal cancer. Our study, however, had a sample size that was too small and the span of study was too short. Consequently, our results may be less persuasive. A larger study enrolling more subjects should be carried out in the future to obtain a more accurate study conclusion.

In conclusion, enteral and parenteral nutritional interventions can effectively elevate immune function, improve nutrition status and health condition, decrease incidence of complications, and significantly shorten length of stay

for patients after surgery. These interventions have better safety and feasibility profiles. They are reliable and worthy of application. More studies on enteral and parenteral nutritional interventions could elevate efficacy of nutritional interventions, greatly benefiting esophageal cancer patients.

Disclosure of conflict of interest

None.

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References

[1] Modi RM, Mikhail S, Ciombor K, Perry KA, Hinton A, Stanich PP, Zhang C, Conwell DL and Krishna SG. Outcomes of nutritional interventions to treat dysphagia in esophageal cancer: a population-based study. Dis Esophagus 2017; 30: 1-8.

[2] Lu HY and Yu GP. Effect of early nutritional support and nursing intervention on gastrointestinal function after esophageal cancer surgery. Journal of Nanchang University (Medical Sciences) 2013; 53: 56-59.

[3] Ling Y and Liu P. Under the whole cavity mirror nursing intervention of patients with esophageal cancer radical surgery. China Continuing Medical Education 2015; 118: 7557-7565.

[4] Hiyoshi Y, Morita M, Kawano H, Otsu H, Ando K, Ito S, Miyamoto Y, Sakamoto Y, Saeki H, Oki E, Ikeda T, Baba H and Maehara Y. Clinical significance of surgical resection for the recurrence of esophageal cancer after radical esophagectomy. Ann Surg Oncol 2015; 22: 240-246.

[5] Liang H, Yang Z, Yu P, Fan JH and Qiao YL. Fresh fruit intake may decrease long-term risk of esophageal cancer death among smokers based on results from the Linxian nutrition intervention trail. Annals of Global Health 2017; 83: 170.

[6] Murphy G, Freedman ND, Michel A, Fan JH, Taylor PR, Pawlita M, Qiao YL, Zhang H, Yu K, Abnet CC and Dawsey SM. Prospective study of Helicobacter pylori antigens and gastric noncardia cancer risk in the nutrition intervention trial cohort. Int J Cancer 2015; 137: 1938-1946.

[7] Vitale A, Peck-Radosavljevic M, Giannini EG, Vibert E, Sieghart W, Van Poucke S and Pawlik TM. Personalized treatment of patients with very early hepatocellular carcinoma. J Hepatol 2017; 66: 412-423.

[8] Chao PC and Lin CF. Successful early elemental diet nutritional support in an esophageal cancer patient: a case report. Journal of Cancer Research & Practice 2016; 4: 66-71.

[9] Daster S, Soysal SD, Koechlin L, Stoll L, Peterli R, von Flue M and Ackermann C. Perioperative outcomes of esophageal cancer surgery in a mid-volume institution in the era of centralization. Langenbecks Arch Surg 2016; 401: 787-795.

[10] Yamamoto M, Yamasaki M, Sugimoto K, Maekawa Y, Miyazaki Y, Makino T, Takahashi T, Kurokawa Y, Nakajima K, Takiguchi S, Rakugi H, Mori M and Doki Y. Risk evaluation of postoperative delirium using comprehensive geriatric assessment in elderly patients with esophageal cancer. World J Surg 2016; 40: 2705-2712.

[11] Lee A, Wong AT, Schwartz D, Weiner JP, Osborn VW and Schreiber D. Is there a benefit to prolonging the interval between neoadjuvant chemoradiation and esophagectomy in esophageal cancer? Ann Thorac Surg 2016; 102: 433-438.

[12] Kishida Y, Kakushima N, Kawata N, Tanaka M, Takizawa K, Imai K, Hotta K, Matsubayashi H and Ono H. Complications of endoscopic dilation for esophageal stenosis after endoscopic submucosal dissection of superficial esophageal cancer. Surg Endosc 2015; 29: 2953-2959.

[13] Bossola M. Nutritional interventions in head and neck cancer patients undergoing chemoradiotherapy: a narrative review. Nutrients 2015; 7: 265-276.

[14] Ida S, Watanabe M, Yoshida N, Baba Y, Umezaki N, Harada K, Karashima R, Imamura Y, Iwagami S and Baba H. Sarcopenia is a predictor of postoperative respiratory complications in patients with esophageal cancer. Ann Surg Oncol 2015; 22: 4432-4437.

[15] Stepanic V, Gasparovic AC, Troselj KG, Amic D and Zarkovic N. Selected attributes of polyphenols in targeting oxidative stress in cancer. Curr Top Med Chem 2015; 15: 496-509.

[16] Otowa Y, Nakamura T, Takiguchi G, Urakawa N, Ishida R, Imanishi T, Suzuki S, Tanaka K, Kuroda D and Kakeji Y. Successful treatment of quintuple primary cancer, including esophageal cancer: a case report. Oncol Lett 2015; 9: 2583-2585.

[17] Greene CL, Worrell SG and DeMeester TR. Rat reflux model of esophageal cancer and its implication in human disease. Ann Surg 2015; 262: 910-924.

[18] Wullstein C, Ro-Papanikolaou HY, Klingebiel C, Ersahin K and Carolus R. Minimally invasive

techniques and hybrid operations for esophageal cancer. Viszeralmedizin 2015; 31: 331-336.

[19] Morita M, Saeki H, Okamoto T, Oki E, Yoshida S and Maehara Y. Tracheobronchial fistula during the perioperative period of esophagectomy for esophageal cancer. World J Surg 2015; 39: 1119-1126.

[20] Bowrey DJ, Baker M, Halliday V, Thomas AL, Pulikottil-Jacob R, Smith K, Morris T and Ring A. A randomised controlled trial of six weeks of home enteral nutrition versus standard care after oesophagectomy or total gastrectomy for cancer: report on a pilot and feasibility study. Trials 2015; 16: 531.

[21] Yi CR and Kuang XC. Nutritional risk screening and effect evaluation of enteral nutrition and parenteral nutrition in postoperative patients with gastric cancer. Department of Geriatric Surgical, Xiangya Hosptial of Central South University 2017; 14: 109-112.