Nutritional Support in Esophageal Cancer

17

Tiffany Barrett

Malnutrition

Poor nutritional intake and weight loss due to cancer diagnosis or treatment can lead to malnutrition. Before diagnosis, 80% of all patients with esophageal cancer has over 10% of unintentional weight loss. Malnutrition is defined as "a state of nutrition in which a deficiency or excess or imbalance of energy, protein and other nutrients causes measurable adverse effects on tissue/body form and function and clinical outcome" [1]. Malnutrition leads to impaired immune response, reduced muscle strength, increased fatigue, impaired wound healing, impaired psycho-social function, reduced quality of life, reduced response, and tolerance to prescribed oncology treatment [2]. Malnutrition during cancer is a result of increased nutrient requirements, inadequate intake, decreased gastrointestinal absorption, and impaired digestion of nutrients. In 2009, the American Society for Parenteral and Enteral Nutrition (ASPEN) and the Academy of Nutrition and Dietetics developed a workgroup to standardize an approach to the diagnosis of malnutrition. Prior to this consensus, there was no universal approach to the diagnosis of adult malnutrition [3]. The identification of two or more of the six characteristics is recommended for diagnosis of either severe or nonsevere malnutrition (Table 17.1): weight loss, insufficient energy intake, loss of muscle mass, loss of body fat, fluid accumulation, and diminished functional status as measured by hand grip strength. Height and weight should be measured not estimated to determine body mass index.

T. Barrett (✉)
Winship Cancer Institute of Emory University, Nutritional Support in Esophageal Cancer, Atlanta, GA, USA
e-mail: Tiffany.barrett@emoryhealthcare.org

N. F. Saba, B. F. El-Rayes (eds.), *Esophageal Cancer*,
https://doi.org/10.1007/978-3-030-29832-6_17

Table 17.1 Clinical characteristics of malnutrition

	Malnutrition in the context of acute illness		Malnutrition in the context of chronic illness		Malnutrition in the context of social or enviromental circumstances	
Clinical characteristic	Moderate	Severe	Moderate	Severe	Moderate	Severe
Weight loss	1–2% 1 week 5% 1 month 7.5% 3 months	>2% 1 week >5% 1 month >7.5% 3 months	5% 1 month 7.5% 3 months 10% 6 months 20% 1 year	>5%1 month >7.5% 3 months >10% 6 months >20% 1 year	5%/1 month 7.5%/3 months 10%/6 months 20%/1 year	>5%/1 month >7.5%/3 months >10%/6 months >20%/1 year
Energy intake	<75% of estimated energy requirement for >7 days	≤50% of estimated energy requirement for ≥5 days	<75% of estimated energy requirement for ≥1 month	≤75% of estimated energy requirement for ≥1 month	<75% of estimated energy requirement for ≥3 months	≤50% of estimated energy requirement for ≥1 month
Physical loss of subcutaneous fat	Mild	Moderate	Mild	Severe	Mild	Severe
Physical muscle loss	Mild	Moderate	Mild	Severe	Mild	Severe
Fluid accumulation generalized or localized evident on exam	Mild	Moderate to severe	Mild	Severe	Mild	Severe
Reduced grip strength	NA	Measurably reduced	NA	Measurably reduced	NA	Measurably reduced

Usual weight should be obtained in order to determine the percentage and to interpret the significance of weight loss. The National Center for Health Statistics defines "chronic" as a disease/condition lasting 3 months or longer. Serum proteins such as albumin and prealbumin are not included as defining characteristics of malnutrition because recent evidence analysis shows that serum levels of these proteins do not change in response to changes in nutrient intake

This table was developed by Annalynn Skipper, PhD, RD, FADA. The content was developed by an Academy workgroup composed of Jane White, PhD, RD, FADA, LDN, Chair; Maree Ferguson, MBA, PhD, RD; Sherri Jones, MS, MBA, RD, LDN; Ainsley Malone, MS, RD, LD, CNSD; Louise Merriman, MS, RD, CDN; Terese Scollard, MBA, RD; and Annalynn Skipper, PhD, RD, FADA and Academy staff member Pam Michael, MBA, RD. Content was approved by an ASPEN committee consisting of Gordon L. Jensen, MD, PhD, Co-Chair; Ainsley Malone, MS, RD, CNSD, Co-Chair; Rose Ann Dimaria, PhD, RN, CNSN; Christine M. Framson, RD, PhD, CSND; Nilesh Mehta, MD, DCH; Steve Plogsted, PharmD, RPh, BCNSP; Annalynn Skipper, PhD, RD, FADA; Jennifer Wooley, MS, RD, CNSD; and Jay Mirtallo, RPh, BCNSP Board Liaison and ASPEN staff member Peggi Guenter, PhD, CNSN. Subsequently, it was approved by the ASPEN Board of Directors. The information in the table is current as of February 1, 2012. Changes are anticipated as new research becomes available.

Adapted from: Skipper A. Malnutrition coding. In Skipper A (ed). *Nutrition Care Manual.* Chicago, IL: Academy of Nutrition and Dietetics; 2012 Edition

Nutrition Screening and Assessment

Early screening for malnutrition is important for improved outcomes. Nutrition screening identifies patients who may have a malnutrition diagnosis and benefit from an assessment by a registered dietitian. Several screening tools are available though there is not an agreement on the best way of screening the nutrition status for cancer patients. Validated tools in oncology patients include the malnutrition screening tool (MST), the malnutrition universal screening tool (MUST), patient-generated subjective global assessment (PG-SGA), and subjective global assessment. Evidence-based practice has recommended the use of scored patient-generated subjective global assessment (PG-SGA) within the oncology population [4]. Due to time constraints in a hospital or clinic setting, simplified screening methods can be beneficial. Development and research of patient-generated subjective global assessment short form (PG-SGA SF). Abbott et al. demonstrated an accurate and simple tool to detect risk of malnutrition when administered by a registered dietitian [4]. Malnutrition screening tool (MST) is a simple and quick tool consisting of two questions. It is a reliable tool for identifying malnutrition in adult oncology patients [5]. The MST has been shown to be validated and reliable. Decreased oral intake and weight loss should be addressed early in diagnosis. Early nutritional intervention assists with identifying the nutritional needs and can improve clinical outcomes.

Nutritional Needs of the Esophageal Cancer Patient

At cancer diagnosis, changes occur in carbohydrate, lipid, and protein metabolism. These abnormalities are the result of an inflammatory response of the tumor in addition to treatment side effects. This inflammation caused by the tumor has been defined as disease-related malnutrition [6]. Pro-inflammatory cytokines produced by the tumor disrupt metabolism in the body causing muscle wasting, fatigue, depression, and decreased physical activity [7].

Elevated resting energy expenditure (REE) has been found higher in esophageal, gastric, pancreatic, and lung cancer. Evaluating resting energy expenditure of newly diagnosed cancer, 46.7% were hypermetabolic, 43.5% were normometabolic, and 9.8% were hypometabolic [8]. Approximately 50% of cancer patients that lost weight were hypermetabolic compared to controls with similar weight loss [9]. Increased resting energy expenditure is due to hypermetabolism contributing to a negative nitrogen balance [10]. To maintain weight and prevent worsening malnutrition, the nutrition intake needs to meet energy requirements. The gold standard to determine resting energy needs is by indirect calorimetry. Indirect calorimetry calculates resting energy expenditure by measuring oxygen consumption and carbon dioxide production [11]. If calorimeters are not available, nutrient requirements are estimated by predictive equations. Commonly used equations include the Mifflin-St Jeor, the Harris-Benedict, Ireton-Jones, Penn State (critically ill), and kcal/kg equation [12]. There is limited research specific to esophageal cancer on estimating calories using predictive equations. Energy expenditure by indirect calorimetry using activity factors was compared to Harris-Benedict and pocket equation. Estimating calories using equation 30 kcal/kg was suitable in a small study of digestive tract cancers [11]. Newly diagnosed esophageal patients with weight loss have elevated energy expenditure and higher inflammation markers. Thirty-eight out of fifty-six patients were found to be hypermetabolic using both indirect calorimetry and predicted energy equation Harris-Benedict [13]. Other research has found Harris-Benedict to underestimate basal energy expenditure and overestimate when used with an injury factor. The results of basal energy needs for indirect calorimetry and Harris-Benedict (1.3 injury factor) equation were 1421.8 and 1703.8, respectively [14].

Protein is essential for building and repairing cells and maintaining muscle mass. Assuming normal renal function, protein needs range from 1.0 to 1.6 g/kg based on weight changes and lean body mass [15]. Fluid needs are based on nutrition assessment by using common equations:

- Body surface area = 1500 mL/m^2
- 1 mL fluid per 1 kcal of estimated energy needs
- Body weight 20–40 mL/kg/day

Vitamin and minerals should be supplied based on RDA recommendations unless tested deficiency. Estimating nutritional needs is based on physical assessment and current clinical data. Needs should be reassessed during intervals of treatment.

Sarcopenia

Sarcopenia is the loss of muscle mass and strength that commonly occurs in cancer patients. CT assessment is the gold standard method of analyzing muscle mass body composition in cancer patients, but is not always practical as a nutrition screening tool. Sarcopenia indicated poor prognosis in esophageal cancer patients without lymph node involvement status post-surgical resection or chemoradiation. Skeletal muscle mass was measured using standard computed tomography scans [16]. In a small study following participants from diagnosis to post-adjuvant therapy, both lean body and hand grip strength were reduced. Leading that nutrition support and exercise interventions should be recommended during preoperative therapy [17]. In another retrospective study, sarcopenia impacts long-term outcome following treatment for esophageal cancer. Sarcopenia was found in 61.5% of patients receiving neoadjuvant treatment with 28.5% having postoperative complications. Complications included pneumonia, anastomotic leakage, and conduit necrosis [18]. Loss of muscle and fat mass can often be disguised in overweight cancer patients who experience more weight loss when compared to underweight patients. Of the 72 studied esophageal patients, 43% was sarcopenic, and 14% had sarcopenic obesity, which is defined as sarcopenia with overweight and obesity based on body mass index (BMI). Dose-limiting toxicity during chemotherapy was high in both groups but higher in sarcopenic obesity [19]. Demonstrating the importance of nutrition intervention for all patients despite BMI, leading that sarcopenia can affect long-term outcome.

Nutrition During Treatment

As previously mentioned, weight loss, fatigue, and dysphagia are already present at the time of diagnosis. Treatments for esophageal cancer contribute to the development of malnutrition after diagnosis. Weight loss before the start of treatment has been shown to occur in up to 74% of patients and during treatment 40–57% [20]. Treatments are typically multimodal: surgery, chemotherapy, and radiation.

Adjuvant chemotherapy or chemoradiotherapy is common for the treatment of esophageal cancer. Chemotherapy-related toxicities include anemia, leukemia, fatigue, appetite changes, and stomatitis and taste aversions. Approaches to reduce the chemotherapy toxicities is needed for full benefit of treatment. Esophagitis is the main side effect during radiation, with nausea, vomiting, and anorexia common with chemotherapy. A complete nutrition assessment should not be ignored in this population. A retrospective study of esophageal patients treated with chemotherapy or radiation found a decline in weight loss of 3.5%. During treatment, 10% of curative patients did not meet with a dietitian despite prior weight loss. Patients that required a feeding tube completed treatment, with 72.2% completed treatment that required a stent [21]. This study concludes the importance of dietitian referral in a timely manner, with frequent follow-up during treatment. Including implementing a protocol of when to implement a feeding tube.

Limited data on the effectiveness of enteral nutrition reducing toxicities during chemotherapy is known. There is clinical evidence supporting enteral nutrition especially malnourished cancer patients. A randomized study revealed chemotherapy adverse effects leukopenia and neutropenia were reduced in patients supplemented with omega-3 containing enteral formula [22]. Omega-3 fatty acid support did not affect neutropenia, but did decrease stomatitis and diarrhea frequency [23]. Patients consumed ω-3 fatty acid-rich supplement orally or by nasogastric tube day 3 before chemo to day 12. Placing prophylactic feeding tubes prior to chemoradiotherapy can be controversial due to lack of evidence and complications from placement. Patients receiving induction chemotherapy and high-dose radiation therapy and experiencing greater weight loss (7.5% compared to 4.5%) were associated with feeding tube placement [24], concluding these patients should be followed closely and reevaluated to prevent nutrition decline during treatment.

Dysphagia and weight loss associated with diagnosis will continue to worsen during neoadjuvant therapy (chemotherapy alone or concurrent with radiation). Self-expanding stents have been used to allow increased oral intake and maintain nutrition status during neoadjuvant therapy. In patients hospitalized with dysphagia, placement of feeding tubes is the most common intervention [25]. Nutrition therapy prior to initiation of neoadjuvant therapy restores normal swallowing, maintains weight, and may prevent feeding tube placement. Patients were provided an individualized regimen as determined by a dedicated upper gastrointestinal cancer nutritionist. Follow-up meetings continued during neoadjuvant chemotherapy to maximize macronutrient intake. Of the 130 patients treated, 78 reported dysphagia at baseline. Weight did not significantly change after one cycle of chemotherapy. Intense nutrition support prior and during treatment assisted with resuming oral intake [26].

Surgical Resection

After concurrent chemotherapy and radiation, patient's immune system can be comprised with esophagectomy further causing immune suppression. Side effects of surgery include early satiety, reflux, nausea, vomiting, dumping syndrome, dysphagia, anastomotic leak, and pain. Literature reports prevalence of postoperative symptoms dysphagia (35.7%), delayed gastric emptying (37%), reflux (39.4%), and dumping syndrome (21.4%) [27]. The normal gastrointestinal structure is altered causing intolerance to oral intake Importance should be paid to nutritional support preoperative and postoperatively. A worse overall 5-year survival in patients with preoperative weight loss (≥10%) after esophagectomy was found in a 2014 cohort study [28]. This current study did not observe increase in post-op complications. In a review by Steenhagen et al., patients with preoperative weight loss was associated with worse outcomes and increasing post-surgical complications [29]. The preoperative prognostic nutritional index is a parameter for evaluating nutritional condition, immunology, and surgical risk: 10x serum albumin level (g/dl) + 0.005 x lymphocyte count in peripheral blood [30]. The PNI of salvage esophagectomy patients affects their overall survival [31]. Prior to esophagectomy, patients are likely immune suppressed due to chemotherapy and radiation, which leads to increased nutrition support and assessment. Parameters of pretreatment nutritional status were evaluated in a study of 101 esophageal patients eligible for neoadjuvant chemoradiation. Body weight, body mass index, handgrip strength, bioelectrical impedance analysis (measure fat-free mass), current energy, and protein intake were collected. Forty-nine percent of patients demonstrated deterioration of nutritional status, and 22% patients lose >5% weight. Malnutrition prevalence increased from pre-chemoradiation 8% to post-chemoradiation 17% [20]. Patients with higher risk for deterioration had higher fat-free mass. It is recommended to carefully evaluate all patients both well-nourished and malnourished.

Perioperative Nutrition

Perioperative nutrition support for patients at high risk for malnutrition has been studied including carbohydrate treatment, vitamin D supplementation, and immunonutrition. Vitamin D deficiency is thought to worsen postoperative lung injury. There is limited data on Vitamin D deficiency and supplementation perioperative for esophagectomy. Immunonutrition refers to supplementation of nutrients including arginine, omega-3 fatty acids, and glutamine. These nutrients enhance the immune system, are anti-inflammatory, and stimulate protein syntheses. Immunonutrition has been reviewed in major surgery, burns, trauma, and critical illness. The timing, delivery method, quantity, and combinations of nutrients have all been studied. In a systematic review of 19 trials, reduced wound infection following gastrointestinal surgery was found. Gastrointestinal surgeries are included in the review: total and subtotal gastrectomy, pancreatectomy, and esophagectomy. Shorter hospital length of stay and reduced risk of wound infection are found with the enteral immunonutrition group, though inconsistencies were found due to study size and population. Also immunonutrition could be beneficial for specific patients (e.g., diabetics and malnourished) [32].

Omega-3 fatty acids (ω-3 fatty acids) are polyunsaturated fatty acids that have a number of functions in the body including reducing inflammation. The three types of omega-3 fatty acids are α-linolenic acid (ALA), eicosapentaenoic acid (EPA), and docosahexaenoic acid (DHA) [33]. Postoperatively following esophagectomy, patients supplemented with enteral immunonutrition formula improved oxygenation and maintained body composition. The formula contained eicosapentaenoic acid, γ-linolenic acid, and antioxidants, and control group received standard formula. All participants were initiated on continuous feedings 48 h post-op and continued for 2 weeks by jejunostomy tube. Subjects did not receive formula preoperatively [34]. The anti-inflammatory properties of immunonutrition formula were thought to improve the oxygenation.

Enhanced recovery after surgery (ERAS) protocol was developed and implemented in colorectal surgery and reduced length of stay without increase in complications. The goal of the protocol is to improve postoperative recovery. ERAS has expanded to include other surgical sites and also involing the multidisciplinary team including dietitians. Benton et al. found patients on ERAS protocol initiated oral intake earlier and upgraded to solids when compared to control group. Patients undergoing esophagectomy were assessed by registered dietitian preoperatively, jejunostomy tube was placed during surgery, and enteral nutrition was initiated day 1 following surgery (Table 17.2) [35]. Overnight fasting prior to surgery depletes glycogen stores and increased catabolism. There is now evidence that clear liquids 2 h prior to surgery and solids 6 h are safe [36]. To reduce the loss of skeletal muscle, carbohydrate loading had gained popularity. Studies on fasting and carbohydrate loading are limited with esophagectomy but have been performed in other

Table 17.2 Diet advancement after esophagectomy

Surgical time frame	Usual care	ERAS
−7	Food diary	Food diary
0	Surgery	Surgery
+1	J tube feeding starts	J tube feeding starts
+3		Clear fluids + J tube
+6	Clear fluids and J tube	Oral fluids + overnight 50% J tube feeds
+7	Oral fluids and J tube feeds	Oral soft diet+ overnight J tube feeds
+8		Discharge
+12	Discharge	

surgeries. Carbohydrate loading 2–3 h prior to surgery shows reduced postoperative insulin resistance and protein loss [29].

Oral intake after esophagectomy is delayed due to risk of aspiration pneumonia and anastomotic leakage. Evidence to evaluate safety is needed. Following immediate oral intake of clear liquids, 28% developed pneumonia compared to 40% of the delayed intake. Tube feeding was required in 38% of patients as oral intake was not tolerated. Advancing oral intake only without enteral may result in insufficient energy and protein intake, worsening malnutrition. Complications should be monitored closely [37].

Early enteral feeding is a consideration to reduce complications after esophagectomy. Early feeding definition has changed over the years and been controversial after an esophagectomy. Subjects that received enteral nutrition within 48 h of surgery had the earliest fecal passage and lowest length of stay and hospitalization expenses. The present study included enteral nutrition initiated within 48 h, 48–72 h, or after 72 h. The longer the length of time to initiate enteral nutrition, the higher the incidence of pneumonia and worse nutrition status [38].

Postoperative

Weight loss following esophagectomy is highest within the first 6 months due to inadequate energy and protein intake and most likely due to long-term gastrointestinal symptoms. Postoperatively patients lost 5–12% of weight at 6 months and >10% at 12 months (Table 17.3) [39]. Other studies have reported 6 months postoperatively weight loss of >10% of body weight in 60% of patients and >20% loss of weight in 20% of studied patients [40]. Enteral nutrition support varied among studies within time frame and percentage of meeting nutrient needs. Demonstrating the importance on long-term nutrition support and management of symptoms.

Home Tube Feeding Postoperatively

Postoperative home jejunostomy feeding varies from centers and is selective based on patients' nutrition at discharge. Indications include post-op complications, poor oral intake tolerance, or increased weight loss. After surgery, enteral nutrition can assist the transition to oral intake while preventing nutrition decline. At 6 weeks patients not using jejunostomy tube lost 3.9 kg more than intervention group receiving enteral feedings. These differences continued at 3–6-month follow-up. Home feeding was re-started in the control group at 33% due to loss of fat and muscle [41]. At discharge oral intake is poor, meeting only 9% for calorie and 6% protein needs. After 3 months, intake improves 61% calorie and 55% for protein needs. In this study, home jejunostomy feedings contributed to calorie and protein needs to supplement poor oral intake. This was an advantage in preventing weight loss and preserving strength. Twenty-six percent of participants not receiving home enteral support required rescue feedings, with overall 76% of participants receiving

Table 17.3 Nutrition symptoms after esophagectomy

Author	Data collection time	Assessment tool	Patient reported symptoms
Ginex et al.	6 m, 12 m	MSAS-SF	Dysphagia 30% (6 m), 22% (12 m) Anorexia 33% (6 m), 27% (12 m) Feeling bloated 40% (6 m), 42% (12 m) Reflux 38% (6 m), 44% (12 m)
Greene et al.	Single point (10–19 yr)	GIQLIMOS SF-36	Dysphagia 12% Postprandial dumping 33% Early satiety 50% Reflux 19%
Haverkort et al.	1 wk, 1 m, 3 m, 6 m, 12 m	Non-validated institutional questionnaire	Dysphagia 53–63% (all time points) Postprandial dumping 74–78% (all time points) Anorexia 51–76% (all time points) Early satiety 87–90% (all time points) Reflux 54–65% (all time points)
McLarty et al.	Single point (5 yr)	Non-validated institutional questionnaire MOS SF-36	Dysphagia 25% Odynophagia 9% Dumping 50% Reflux 60%

jejunostomy feeding [42]. In a result from a prospective cohort study, home enteral nutrition was tolerated with compliance and patient satisfaction. One hundred forty-nine patients were studied, and overnight enteral nutrition by jejunostomy tube continued 4 weeks after discharge. Tube was removed if weight was maintained within 5 kg of discharge weight. At 6 months, 39% of patients lost >10% of weight compared preoperatively. The type of neoadjuvant treatment did not affect weight loss results. Responses from patient satisfaction included enhanced recovery, reduced worry about weight loss, allowed earlier discharge, and reassurance about adequate intake [43], which continues with the question on how much weight loss is acceptable and percentage of supplemental nutrition should be recommended during recovery. Zeng et al. found 12 weeks after esophagectomy incidence of malnutrition was less in patient receiving home enteral nutrition. Patients had resumed fully oral intake within 24 weeks post-surgery. Quality-of-life scores were higher in the enteral group at 12 weeks, but similar to control at 24 weeks. Increased diarrhea was found in the home enteral group which could be related to pump rate and formula selection [44]. Patients decided by themselves when to decrease enteral feedings based on oral intake without recommendations of a trained nutrition professional. To support the benefit of home enteral nutrition, another study found malnutrition was reduced with improved quality of life 3 months after esophageal surgery. BMI, albumin, and hemoglobin were higher in the home enteral nutrition group after

3 months. And patients reported nausea, vomiting, fatigue, and pain [45]. Patients were able to manage feeding tube pump independently after education and guidelines to decrease rate based on improvement in oral intake. Tube feeding placement does have complications including clogging, dislodgement, skin irritation, and leakage. Jejunostomy tube complications were increased in gastrectomy than esophagogastrectomy [46]. The majority of complications were easily resolved by telephone or clinic follow-up. Extended jejunostomy feedings meeting macronutrient and micronutrient needs play an important role in body status and malnutrition.

Long-Term Nutrition

As the survival rate in patients following esophagectomy increases, quality of life is important. Symptoms of dysphagia, reflux, diarrhea, dumping syndrome, and nausea persisted at 12 months. Weight loss greater than 10% at 6 months was found in 41% of patients investigated and 33% at 12 months [47]. Weight loss, persistent eating difficulties, and reduced quality of life have been found to persist up to 10 years in a small cohort study [48], which demonstrate the need for continuous nutrition support for these patients long term. Dietitian-directed nutrition support has been shown to reduce postoperative complications. Twenty-eight patients post-esophagectomy received diet counseling from surgical oncology dietitians. Patients were provided diet recommendations and tube feeding if unable to meet set goals. Patients also received follow-up until a year after surgery. Patients in the nutrition therapy group have increased weight, less postoperative complications, and reduced length of hospital stay [49].

Managing Side Effects

When esophageal patients need to relearn how to eat again nutrition support and education should be provided. Patients can be assisted with making a timetable dividing intake into 5–6 meals daily. Smaller volumes are better tolerated foods with high nutritional content rec. Modify the consistency of food, and give smaller quantities to ease swallowing and prevent fatigue. Food with soft moist texture if solid, creamy if liquids. Foods at room temp, oral hygiene, avoid irritants. For patients who are not able to meet nutritional feedings orally should be.

Side effect	Nutrition intervention
Poor appetite/early satiety	Frequent small meals of calorie-dense foods Protein-rich small meals Eat by time not by hunger cues/view eating as treatment Easy to prepare meals/snacks Consume liquids between meals instead of with meals
Nausea/vomiting	Limit exposure to food odors Avoid high-fat, greasy foods Liquids between meals Foods at room temperature

Side effect	Nutrition intervention
Diarrhea/dumping	Multiple small meals Avoid fluids with meals Avoid intake of simple sugars Protein-rich foods Increase soluble fiber
Mucositis/esophagitis	Soft foods: add sauce, gravy, and oils Oral hygiene Limit acidic, citrus-based foods Foods at room temperature

Recommendations from patients for improving nutrition care [50]:

– Provide consistent nutrition messaging and practice
– Provide detailed instruction on home tube feeding
– Specialized dietitian assessment with specific goals
– Emphasize real food over oral nutrition supplements
– Educate family members throughout the treatment process
– Discuss rehabilitation at the beginning of treatment and continue after all treatments are completed

Summary

Esophageal cancer patients have many barriers to maintain adequate nutrition status. Increased incidence of malnutrition is associated with reduced treatment efficacy, increased morbidity, and hospital admissions. Nutrition support can be accomplished by increasing oral intake with counseling from RD or supplementing with enteral nutrition. Early nutrition education and support provided earlier in diagnosis and throughout the stages of treatment assist with limiting malnutrition and weight loss. A multidisciplinary approach should be developed to coordinate decisions and improve patient outcomes.

References

1. Straton RJ, Hackston A, Longmore D, Dixon R, Price S, Stroud M, King C, Marinos E. Malnutrition in hospital outpatients and inpatients: prevalence, concurrent validity and ease of use of the ‘malnutrition universal screening tool’ (‘MUST’) for adults. Br J Nutr. 2004;92:799–808.
2. Barker LA, Gout BS, Crowe TC. Hospital malnutrition: prevalence, identification and impact on patients and the healthcare system. Int J Environ Res Public Health. 2011;8:514–27.
3. White JV, Guenter P, Jensen G, Malone A, Schofield M, the Academy Malnutrition Work Group, A.S.P.E.N. Malnutrition Task Force and the A.S.P.E.N. Board of Directors. Consensus statement: Academy of Nutrition and Dietetics and American Society for Parenteral and Enteral Nutrition: characteristics recommended for the identification and documentation of adult malnutrition (undernutrition). JPEN J Parenter Enteral Nutr. 2012;36:275–83.
4. Abbott J, Teleni L, McKavanagh D, Watson J, McCarthy A, Isenring E. Patient-generated subjective global assessment short form (PG-SGA SF) is a valid screening tool in chemotherapy outpatients. Support Care Cancer. 2016;24:3883–7.

5. Academy's Oncology Expert Work Group, E. A. (2012).
6. Cederholm T, Barazzoni R, Austin P, Ballmer P, Biolo G, Bischoff S, et al. ESPEN guidelines on definitions and terminology of clinical nutrition. Clin Nutr. 2017;36:49–64.
7. Arends J, Baracos V, Bertz H, Bozzetti F, Calder P, Deutz N, et al. ESPEN expert group recommendations for action against cancer-related malnutrition. Clin Nutr. 2017;36:1187–96.
8. Cao D, Wu G, Zhang B, Quan Y, Wei J, Jin H, et al. Resting energy expenditure and body composition in patients with newly detected cancer. Clin Nutr. 2010;29:72–7.
9. Bosaeus I, Daneryd P, Svanberg E, Lundholm K. Dietary intake, resting energy expenditure in relation to weight loss in unselected cancer patients. Int J Cancer. 2001;93:380–3.
10. Gangadharan A, Choi SE, Hassan A, Ayoub NM, Durante G, Balwani S, et al. Protein calorie malnutrition, nutritional intervention and personalized cancer care. Oncotarget. 2017;8:24009–30.
11. Alves A, Zucnoi CP, Correia MI. Energy expenditure in patients with esophageal, gastric, and colorectal cancer. JPEN J Parenter Enteral Nutr. 2016;40:499–506.
12. Academy EAL. (n.d.).
13. Wu J, Huang C, Xiao H, Tang Q, Cai W. Weight loss and resting energy expenditure in male patients with newly diagnosed esophageal cancer. Nutrition. 2013;29:1310–4.
14. Veronese CB, Guerra LT, Grigolleti SS, Vargas J, Pereira da Rosa AR, Kruel CD. Basal energy expenditure measured by indirect calorimetry in patients with squamous cell carcinoma of the esophagus. Nutr Hosp. 2013;28:142–7.
15. Hamilton KK. Oncology nutrition for clinical practice: nutritional needs of the adult oncology patient. Oncology nutrition dietetic practice group of the academy of nutrition and dietetics. 2013.
16. Harada K, Ida S, Baba Y, Ishimoto T, Kosumi K, Izumi D, et al. Prognostic and clinical impact of sarcopenia in esophageal squamous cell carcinoma. Dis Esophagus. 2016;29:627–33.
17. Guinan E, Doyle S, Bennett A, O'Neill L, Gannon J, Elliott J, et al. Sarcopenia during neoadjuvant therapy for oesophageal cancer: characterising the impact on muscle strength and physical performance. Support Care Cancer. 2018;26:1569–76.
18. Paireder M, Asari R, Kristo I, Rieder E, Tamandl D, Ba-Ssalamah A, Schoppmann S. Impact of sarcopenia on outcome in patients with esophageal resection following neoadjuvant chemotherapy for esophageal cancer. Eur J Surg Oncol. 2017;43:478–84.
19. Anandavadivelan P, Brismar TB, Nilsson M, Johar AM, Martin L. Sarcopenic obesity: a probable risk factor for dose limiting toxicity during neo-adjuvant chemotherapy in oesophageal cancer patients. Clin Nutr. 2016;35:724–30.
20. Rietveld SC, Witvliet-van Nierop J, Ottens-Oussoren K, van der Peet DL, de van der Schueren MA. The prediction of deterioration of nutritional status during chemoradiation therapy in patients with esophageal cancer. Nutr Cancer. 2018;70:1–7.
21. Mak M, Bell K, Ng W, Lee M. Nutritional status, management and clinical outcomes in patients with esophageal and gastro-oesophageal cancers: a descriptive study. Nutr Diet. 2017;74:229–35.
22. Miyata H, Yano M, Yasuda T, Hamano R, Yamasaki M, Hou E, et al. Randomized study of clinical effect of enteral nutrition support during neoadjuvant chemotherapy on chemotherapy-related toxicity in patients with esophageal cancer. Clin Nutr. 2012;31:330–6.
23. Miyata H, Yano M, Yasuda T, Yamasaki M, Murakami K, Makino T, et al. Randomized study of the clinical effects of ω−3 fatty acid-containing enteral formula nutrition support during neoadjuvant chemotherapy on chemotherapy related toxicity in patients with esophageal cancer. Nutrition. 2017;33:204–10.
24. Verma V, Allen PK, Lin SH. Evaluating factors for prophylactic feeding tube placement in gastroesophageal cancer patient undergoing chemoradiotherapy. Font Oncol. 2017;7:235.
25. Modi RM, Mikhail S, Ciombor K, Perry KA, Hinton A, Stanich PP, et al. Outcomes of nutritional interventions to treat dysphagia in esophageal cancer: a population based study. Dis Esophagus. 2017;30:1–8.
26. Cools-Lartigue J, Jones D, Spicer J, Zourikian T, Rousseau M, Eckert E, et al. Management of dysphagia in esophageal adenocarcinoma patients undergoing neoadjuvant chemotherapy: can invasive tube feeding be avoided? Ann Surg Oncol. 2015;22:1858–65.

27. Deldycke A, Daele EV, Ceelen W, Nieuwenhove YV, Pattyn P. Functional outcome after Ivor Lewis Esophagectomy for cancer. J Surg Oncol. 2015;113:24–8.
28. Van Der Schaaf M, Tilanus H, Van Lanschot J, Johar A, Lagergren P, Wijnhoven BP. The influence of preoperative weight loss on the postoperative course after esophageal cancer resection. J Thorac Cardiovasc Surg. 2014;147:490–5.
29. Steenhagen E, van Vulpen JK, Hillegersberg R v, May AM, Siersema PD. Nutrition in perioperative esophageal cancer management. Expert Rev Gastroenterol Hepatol. 2017;11:663–72.
30. Sun J, Wang D, Mei Y, Jin H. Value of the prognostic nutritional index in advanced gastric cancer treated with preoperative chemotherapy. J Surg Res. 2017;209:37–44.
31. Sakai M, Sohda M, Miyazaki T, Yoshida T, Kumakura Y, Honjo H, et al. Association of preoperative nutritional status with prognosis in patients with esophageal cancer undergoing salvage esophagectomy. Anticancer Res. 2018;38:933–8.
32. Wong CS, Aly EH. The effects of enteral immunonutrition in upper gastrointestinal surgery: a systemic review and meta-analysis. Int J Surg. 2016;29:137–50.
33. Omega 3 Supplements: In Depth. (2015, August). Retrieved from National Center for Complementary and Integrative Health: https://nccih.nih.gov/health/omega3/introduction.htm
34. Matsuda Y, Habu D, Lee S, Kishida S, Osugi H. Enteral diet enriched with omega 3 fatty acid improves oxygenation after thoracic esophagectomy for cancer: a randomized controlled trial. World J Surg. 2017;41:1584–94.
35. Benton K, Thomson I, Isenring E, Smithers BM, Agarwal E. An investigation into the nutritional status of patients receiving an enhanced recovery after surgery (ERAS) protocol versus standard care following Oesophagectomy. Support Care Cancer. 2018;26:2057–62.
36. Ljungqvist O. ERAS—enhanced recovery after surgery: moving. JPEN J Parenter Enteral Nutr. 2014;38:559–66.
37. Weijs TJ, Berkelmans GH, Nieuwenhuijzen GA, Dolmans AC, Kouwenhoven EA, Rosman C, et al. Immediate postoperative oral nutrition following esophagectomy: a multicenter clinical trial. Ann Thorac Surg. 2016;102:1141–8.
38. Wang G, Chen H, Liu J, Ma Y, Jin H. A comparison of postoperative early enteral nutrition with delayed enteral nutrition in patients with esophageal cancer. Nutrients. 2015;7:4308–17.
39. Baker ML, Halliday V, Robinson P, Smith K, Bowrey DJ. Nutrient intake and contribution of home enteral nutrition to meeting nutritional requirements after oesophagectomy and total gastrectomy. Eur J Clin Nutr. 2017;71:1121–8.
40. Martin L, Lagergren P. Long-term weight change after esophageal cancer surgery. Br J Surg. 2009;96:1308–14.
41. Bowrey D, Baker M, Halliday V, Thomas AL, Pulikottil-Jacob R, Smith K, et al. A randomised controlled trial of six weeks of home enteral nutrition versus standard care after oesophagectomy or total gastrectomy for cancer: a report on a pilot and feasibility study. Trials. 2015;16:531.
42. Baker M, Halliday V, Williams RN, Bowrey DJ. A systematic review of the nutritional consequences of esophagectomy. Clin Nutr. 2016;35:987–94.
43. Donohoe C, Healy L, Fanning M, Doyle S, Mc Hugh A, Moore J, et al. Impact of supplemental home enteral feeding postesophagectomy on nutrition, body composition, quality of life and patient satisfaction. Dis Esopagus. 2017;30:1–9.
44. Zeng J, Hu J, Chen Q, Feng J. Home enteral nutrition' effect on nutritional status and quality of life after esophagectomy. Asia Pac J Clin Nutr. 2017;26:804–10.
45. Wu Z, Wu M, Wang Q, Zhan T, Wang L, Pan S, Chen G. Home enteral nutrition after minimally invasive esophagectomy can improve quality of life and reduce the risk of malnutrition. Asia Pac J Clin Nutr. 2018;27:129–36.
46. Choi AH, O'Leary MP, Merchant SJ, Sun V, Chao J, Raz DJ, et al. Complications of feeding jejunostomy tubes in patients with gastroesophageal cancer. J Gastrointest Surg. 2017;21:259–65.
47. Soriano T, Eslick G, Vanniasinkam T. Long-term nutritional outcome and health related quality of life of patients following esophageal cancer surgery: a meta analysis. Nutr Cancer. 2018;70:192–203.

48. Anandavadivelan P, Wikman A, Johar A, Lagergren P. Impact of weight loss and eating difficulties in health related quality of life up to 10 years after oesophagectomy for cancer. Br J Surg. 2017;105:410–8.
49. Ligthart-Melis G, Weijs P, te Boveldt N, Buskermolen S, Earthman C, Verheul H, et al. Dietician-delivered intensive nutritional support is associated with a decreased in severe postoperative complications after surgery in patients with esophageal cancer. Dis Esophagus. 2013;26:587–93.
50. Alberda C, Korenic-Alvadj T, Mayan M, Gramlich L. Peer support nutrition care in patients with head and neck or esophageal cancer: the patient perspective. Nutr Clin Pract. 2017;32:664–74.