Clinical Nutrition xxx (2016) 1–6

Contents lists available at ScienceDirect

Clinical Nutrition

journal homepage: http://www.elsevier.com/locate/clnu

Original article

Low fat-containing elemental formula is effective for postoperative recovery and potentially useful for preventing chyle leak during postoperative early enteral nutrition after esophagectomy

Kazuki Moro [a], Yu Koyama [b, *], Shin-ichi Kosugi [c], Takashi Ishikawa [a], Hiroshi Ichikawa [a], Takaaki Hanyu [a], Kohei Miura [a], Masayuki Nagahashi [a], Masato Nakajima [a], Kumiko Tatsuda [a], Junko Tsuchida [a], Chie Toshikawa [a], Mayuko Ikarashi [a], Yoshifumi Shimada [a], Jun Sakata [a], Takashi Kobayashi [a], Hitoshi Kameyama [a], Toshifumi Wakai [a]

[a] Division of Digestive & General Surgery, Niigata University Graduate School of Medical & Dental Sciences, 1-757 Asahimachi, Niigata, Niigata 951-8510, Japan
[b] Department of Nursing, Niigata University Graduate School of Health Sciences, 2-746 Asahimachi, Niigata, Niigata 951-8518, Japan
[c] Department of Digestive and General Surgery, Uonuma Institute of Community Medicine, Niigata University Medical and Dental Hospital, 4132 Urasa, Minami-Uonuma, Niigata, Japan

ARTICLE INFO

Article history:
Received 3 November 2015
Accepted 23 March 2016

Keywords:
Chyle leak
Early enteral nutrition
Esophageal cancer
Low fat-containing elemental formula
Thoracic duct

SUMMARY

Background and aims: Transthoracic esophagectomy using 3-field lymphadenectomy (TTE-3FL) for esophageal cancer is one of the most aggressive gastrointestinal surgeries. Early enteral nutrition (EN) for TTE-3FL patients is useful and valid for early recovery; however, EN using a fat-containing formula risks inducing chyle leak. In the present study, we retrospectively examined esophageal cancer patients treated byTTE-3FL and administered postoperative EN to elucidate the validity of lowering the fat levels in elemental formulas to prevent postoperative chyle leak and improve postoperative recovery.

Methods: A total of 74 patients who received TTE-3FL for esophageal cancer were retrospectively examined. Patients were classified into two groups according to the type of postoperative EN: Group LF patients received a low-fat elemental formula, and Group F patients received a standard fat-containing polymeric formula. The following clinical factors were compared between the groups: EN start day, maximum EN calories administered, duration of respirator use, length of ICU stay, incidence of postoperative infectious complications, use of parenteral nutrition (PN), and incidence of postoperative chyle leak.

Results: Patients in Group LF were started on EN significantly earlier after surgery and they consumed significantly higher maximum EN calories compared to Group F patients ($P < 0.01$). Duration of respirator use and length of ICU stay were also significantly shorter, and TPN was used significantly less in Group LF compared to Group F ($P < 0.05$). Postoperative chyle leak was observed in six patients in total (8.1%); five patients in Group F and one patient in Group LF, although there was no significant difference in frequency of chyle leak per patient between Group LF and Group F.

Conclusions: Early EN using low-fat elemental formula after esophagectomy with three-field lymphadenectomy was safe and valid for postoperative recovery and potentially useful in preventing chyle leak.

1. Introduction

Chyle leak such as chylous ascites or chylothorax is a rare complication after esophagectomy, having a reported incidence of 0.6–10% [1–6]. It can lead to hypovolemia, infection, metabolic and nutritional depletion, and more than 50% mortality if untreated [7].

Abbreviations: TTE-3FL, Transthoracic esophagectomy with 3-field lymphadenectomy; EN, enteral nutrition; TPN, total parenteral nutrition; LCT, long chain triglycerides; SIRS, systematic inflammatory response syndrome; VATs-E, video-assisted thoracoscopic esophagectomy; MCT, middle-chain triglycerides; FEV_1, forced expiratory volume in one second.

* Corresponding author. Tel./fax: +81 25 227 2361.
E-mail address: yukmy@clg.niigata-u.ac.jp (Y. Koyama).

http://dx.doi.org/10.1016/j.clnu.2016.03.018

Transthoracic esophagectomy accompanied by 3-field lymphadenectomy (TTE-3FL) is one of the most aggressive procedures among digestive surgeries. Postoperative administration of early enteral nutrition (EN) is useful and valid for aiding early recovery in patients undergoingTTE-3FL [8,9]. However, because the fat contained in standard EN formula, and especially long-chain triglycerides (LCT), is generally transported from intestinal cells as chylomicron via the intestinal lymphatic ducts [10], early EN using such formula after TTE-3FL may induce the risk of chyle leak such as chylothorax or chylous ascites. In fact, restricting or eliminating oral and enteral fat intake can reduce chyle flow, and total elimination of fat intake is one of the conservative treatments for chylothorax [10]. Therefore, EN using a low-fat formula might reduce the risk of chyle leak and thus improve early recovery following TTE-3FL.

In the present study, we retrospectively examined esophageal cancer patients who underwent TTE-3FL and who also received postoperative EN. Our aim was to clarify whether using low-fat elemental formula could more effectively prevent postoperative chyle leak and improve postoperative recovery compared to standard fat-containing formula.

2. Materials and methods

2.1. Selection of patients

Esophageal cancer patients who underwent TTE-3FL at Niigata University Medical and Dental Hospital from 2002 to 2014 were enrolled in this study, which comprised a retrospective analysis by chart review. In total, 74 patients were selected for analysis following approval from the Institutional Review Board for Clinical Research. Our department currently has no systematic protocol in place for the starting sequence for EN or for choosing the EN formula, thus these factors are individually decided according to each patient's condition and the clinical experience of their doctor. Postoperative EN is generally administered in our department for patients undergoing jejunostomy performed simultaneously with esophageal surgery. In this study, patients were retrospectively divided into two groups based on the EN formula administered: Group F contained the patients who started EN with a standard fat-containing polymeric formula (ENSURE LIQUID®; Abbott Japan Co., Ltd., Tokyo, Japan [11], RACOL®; Ohtsuka Chemical Industrial Co., Ltd., Tokushima, Japan [12], or IMPACT®, Ajimonoto Co., Inc., Tokyo, Japan [13]); and Group LF contained the patients who started EN with a low-fat elemental formula (ELENTAL®; Ajimonoto Pharmaceuticals Co., Ltd., Tokyo, Japan [14]). Each EN formula provides energy as 1 kcal/ml, and the composition of carbohydrate, protein or amino acid, and fat are detailed in Table 1.

The starting dose of EN comprised 200–300 ml of elemental or polymeric formula administered at 20–25 ml/h from surgically placed jejunostomy. The dose was increased gradually, every 12–24 h, to a maximum dose on day 5–6 of EN administration if there were no related problems in either group.

In Group LF, the low-fat formula was converted to a standard fat-containing polymeric formula according to the decrease in drain fluid volume. Both groups of patients also received intravenous infusions of electrolytes and 4.3% glucose solution to retain adequate water and electrolyte levels. Supplemental parenteral nutrition (SPN) was also chosen on a patient-by-patient basis, and is defined in this study as an infusion containing amino acids and glucose. Each patient's doctors chose the date of EN conversion, choice of standard fat-containing polymeric formula, and usage of supplemental parenteral nutrition (SPN) on an individual basis. Total parenteral nutrition (TPN) was introduced when EN could not be started at day 5 after surgery.

2.2. Clinical assessment

We compared Groups F and LF according to the follows clinical factors: age, gender, cancer stage according to the classification of tumor-node-metastasis defined by the International Union Against Cancer (6th edition), EN start day, maximum EN calories administered per day, recovery of bowel movement defined as first stool passage date, perioperative change in serum albumin and total cholesterol, length of ICU stay, duration of respirator use, duration of systematic inflammatory response syndrome (SIRS), and use of SPN and/or TPN. Diagnosis of SIRS followed the criteria of the ACCP-SCCM Consensus Conference Committee [15], with at least two of the following criteria required for a diagnosis: respiratory rate >20/min or peripheral arterial CO_2 tension ($PaCO_2$) <32 mmHg, tachycardia >90/min, systolic blood pressure <90 mmHg, leukocytosis >12,000/μl or leukopenia <4000/μl or 10% of immature leukocyte forms, and body temperature >38.0 °C or <36.0 °C.

Patient records were reviewed retrospectively to establish the incidence of postoperative complications. Incidence of postoperative complications, recurrent nerve palsy, infectious complications, and chyle leak were compared between groups. For detection of recurrent nerve palsy, defined as the failure of vocal cord function with/without hoarseness, postoperative laryngofiberscopy was performed in all patients in this study, as previously described [16]. Presence of accompanying infection such as wound infection, pneumonia, and/or sepsis was defined as an infectious complication in this study. The diagnosis of chyle leak was made clinically after observation of a milky drain fluid or by cytological examination to prove the existence of fat droplets in the drain fluid was not milky, but exceeded 500 ml/day.

2.3. Statistics

The statistical comparisons were performed using Mann–Whitney *U* test, adjusted Chi-square test, and two-way analysis of variance (ANOVA). The Exact Chi-square test was used when there were fewer than 5 cells. The statistical significance was defined as a *P*-value <0.05.

3. Results

3.1. Perioperative features

Of the 74 enrolled patients, 53 patients were classified into Group F, and 21 into Group LF (Table 2).

Table 1
Composition of carbohydrate, protein (amino acid), and fat in each enteral formula.

	Fat-containing polymeric formula			Low-fat elemental formula
	ENSURE®	RACOL®	IMPACT®	ELENTAL®
Carbohydrate	13.7	15.6	13.2	21.1
Protein (amino acid)	3.5	4.4	5.5	4.4
Fat	3.5	2.2	2.8	0.17

Each value was expressed as g/100 kcal; ELENTAL was composed of free amino acid as a nitrogen source.

Please cite this article in press as: Moro K, et al., Low fat-containing elemental formula is effective for postoperative recovery and potentially useful for preventing chyle leak during postoperative early enteral nutrition after esophagectomy, Clinical Nutrition (2016), http://dx.doi.org/10.1016/j.clnu.2016.03.018