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Open Versus Thoracoscopic Esophagectomy in Patients with Esophageal Squamous Cell Carcinoma

Po-Kuei Hsu · Chien-Sheng Huang ·
Yu-Chung Wu · Teh-Ying Chou · Wen-Hu Hsu

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Abstract

Background The impact of minimally invasive esophagectomy on patient prognosis, particularly disease-free survival (DFS), has not been well addressed. We compared the clinical outcomes of open and thoracoscopic esophagectomy in patients with esophageal squamous cell carcinoma (ESCC).

Methods Sixty-three and 66 patients, nonrandomized, underwent open and thoracoscopic esophagectomies for ESCC between 2008 and 2011 were included. The clinicopathological data were reviewed retrospectively. Perioperative outcome, overall survival (OS), DFS, and the recurrence sites after open and thoracoscopic esophagectomy were compared.

Results The open and thoracoscopic groups were comparable with regard to the total number of harvested lymph nodes and the percentage patients undergoing R0 resection. Fewer patients in the thoracoscopic group had pneumonia and wound complications. Intensive care unit (ICU) stay also was shorter in the thoracoscopic group. The recurrence pattern was similar in the two groups. In the open and thoracoscopic groups, the 3-year OS rates were 47.6 and 70.9 % ($p = 0.031$), respectively, and the 3-year DFS rates were 35 and 62.4 % ($p = 0.007$), respectively. However, the trends in better OS and DFS in the thoracoscopic group were not significant after stratification according to pathologic stage.

Conclusions The perioperative benefit of thoracoscopic esophagectomy included fewer postoperative complications and shorter ICU stays. Mid-term OS and DFS associated with thoracoscopic techniques are at least equivalent to those associated with open procedures.

P.-K. Hsu (✉) · C.-S. Huang · Y.-C. Wu · W.-H. Hsu
Division of Thoracic Surgery, Department of Surgery, Taipei-Veterans General Hospital, No. 201, Sec. 2, Shih-Pai Road, Taipei, Taiwan
e-mail: hsupokuei@yahoo.com.tw

W.-H. Hsu
e-mail: whhsu@vghtpe.gov.tw

P.-K. Hsu · C.-S. Huang · Y.-C. Wu · T.-Y. Chou · W.-H. Hsu
School of Medicine, National Yang-Ming University, Taipei, Taiwan

P.-K. Hsu · C.-S. Huang · T.-Y. Chou
Institute of Clinical Medicine, National Yang-Ming University, Taipei, Taiwan

T.-Y. Chou
Department of Pathology, Taipei-Veterans General Hospital, Taipei, Taiwan

Introduction

Esophagectomy for the treatment of esophageal cancer is a complex surgery, associated with high morbidity and mortality. Approximately 20–30 % of patients develop postoperative complications, particularly respiratory complications, which are the leading causes of postoperative death [1, 2]. The key disadvantage of conventional open esophagectomy relates to substantial trauma due to the necessary large incisions, which is associated with severe wound pain, systemic inflammatory response syndrome, cell-mediated immune dysfunction, and increased postoperative complication rates [3–5]. Minimally invasive esophagectomy (MIE) and reconstruction have been suggested to decrease operative trauma and complications secondary to the large incisions. Techniques for minimally invasive procedures vary from total minimally invasive to hybrid procedures, in which either the thoracic or the abdominal portion of the operation is performed using endoscopic techniques (e.g., hybrid minimally invasive esophagectomy, HMIE). These procedures have proven to be safe and feasible and result in favorable outcomes compared with open esophagectomy [4–12]. Many single-institution studies as well as meta-analyses have indicated that MIE and HMIE offer advantages over open procedures, such as reduced blood loss, relatively easy mediastinal lymph node dissection, reduced postoperative pain, decreased postoperative pulmonary complication rates, earlier postoperative recovery, and decreased hospital stay [4–14]. However, whether MIE is a viable alternative that is oncologically appropriate is an issue that has not been adequately addressed. Although some authors have used the number of harvested lymph nodes, resection margins, and short-term mortality as surrogate endpoints for oncologic outcomes, the mid-term or long-term influence of MIE is still unknown [6, 12, 15]. Furthermore, whether adequate or radical lymph node dissection can be determined solely based on the number of harvested lymph nodes is controversial, with some studies indicating that the number of harvested lymph nodes does not correlate with outcome [16]. From the viewpoint of surgical oncologists, one of the most important indicators of good cancer treatment is patient survival. Therefore, either long-term overall survival (OS) or disease-free survival (DFS) would be a better parameter to compare the oncologic effects of different surgical techniques. Little information is available regarding the influence of minimally invasive approaches on survival. Our institute began using minimally invasive techniques for esophagectomy 4 years ago. In this study, we compared open esophagectomy with thoracoscopic esophagectomy. Patient outcomes, including mid-term OS, DFS, and the recurrence pattern, after open and thoracoscopic esophagectomy were investigated.

Patients and methods

Study population

A total of 129 consecutive patients undergoing transthoracic esophagectomy for esophageal squamous cell carcinoma (ESCC) in Taipei Veterans General Hospital between January 2008 and January 2011 were reviewed retrospectively. Due to the fact that additional reimbursement was not provided as part of the National Health Insurance, and therefore, patients who refused the uninsured use of the thoracoscopic instruments (e.g., endostapler and harmonic scalpel) underwent conventional open esophagectomy. During this period, 63 esophagectomy procedures were performed using conventional open methods (open group), and 66 were performed using thoracoscopic techniques (thoracoscopic group). Routine preoperative staging workups for esophageal cancer included physical examination, esophagogastroduodenoscopy, flexible bronchoscopy (for upper and middle third tumors), computed tomography (CT) of the neck to the upper abdomen, and whole-body positron emission tomography (PET). Patients deemed medically unfit and those with unresectable tumors due to extensive locoregional invasion that obliterated normal tissue planes were excluded from surgical resection. In 2010, we adopted a multidisciplinary approach for esophageal cancer and started following National Comprehensive Cancer Network (NCCN) guidelines. Esophageal cancers in upper-third location or those with lymph node involvement on imaging studies were considered for concurrent chemoradiation (CCRT) followed by esophagectomy. Adjuvant CCRT was suggested for patients with T3/4 stage disease or positive lymph node involvement. Patients were followed-up as previously described [17, 18]. All patients were followed-up at our outpatient department every 3 months for the first 2 years, every 6 months for years 2–5, and annually thereafter. Routine follow-up examination included measurements of serum tumor markers [e.g., squamous cell carcinoma antigen (SCC)], chest radiography, and CT of the neck to the upper abdomen. Endoscopy, radionuclide bone scans, and PET/CT were performed as indicated clinically. Diagnosis of recurrence was based on histological, cytological, and radiological evidence. Recurrences at anastomotic sites or within areas of previous resection and nodal clearance in the mediastinum or upper abdomen were classified as locoregional recurrence. Distant recurrence was defined as hematogenous metastasis to solid organs or recurrence in the pleura or peritoneal cavity. OS was defined as the interval between surgical resection and death or last known living contact, whereas DFS was defined as the interval between surgical resection and the first detection of recurrence, death, or the last evaluation for recurrence.

Surgical techniques

Open surgery was performed via transthoracic esophagectomy. Esophagectomy and mediastinal lymph node dissection were performed during the thoracic stage. With regard to the extent of lymph node dissection, infracarinal two-field lymphadenectomy plus dissection of the right paratracheal nodes was performed [19]. Esophageal substitute mobilization and dissection of pericardial and enlarged celiac axis nodes were performed during the abdominal stage. In the abdominal stage, hepatic and splenic artery nodes were not dissected routinely. The previous experience in our hospital showed that the frequency of nodal metastasis near celiac trunk was <3 % for upper-middle thoracic ESCC and <10 % for middle third ESCC. We do not perform standard D2 dissection routinely if there is no intra-abdominal uptake on PET–CT scan. The gastric tube was extended to the cervical incision for anastomosis (retrosternal route: $n = 44$; posterior mediastinal route: $n = 19$). Cervical lymph node sampling also was completed during the cervical stage.

With regard to the thoracoscopic techniques, the thoracic stage was completed using endoscopic techniques. In brief, each patient was placed in the semiprone left decubitus position. A camera port was created at the eighth intercostal space (ICS) along the midaxillary line. Two 5- or 12-mm ports were created at the sixth ICS along the anterior axillary line and at the fourth ICS along the midclavicular line for the surgeon's left and right hands. Another 5-mm port was created below the scapula tip for tissue traction. The surgical principle was the same as that in the open method. After complete mobilization, the esophagus was retained in its original position, serving as a guide for the placement of the gastric tube in the posterior mediastinum. In some patients with locally advanced esophageal cancer, the esophagus was divided between the azygos vein and thoracic inlet using endoscopic staplers. The esophagus was removed during the abdominal stage, and gastric reconstruction was performed via the retrosternal route (retrosternal route: $n = 51$; posterior mediastinal route: $n = 14$; no reconstruction: $n = 1$). Because postoperative adjuvant radiation may be needed, the use of this route can avoid the effects of irradiation to the conduit during adjuvant radiotherapy [20]. In the thoracoscopic group, the abdominal stage was completed in the same manner as described for the open group. All resected tissues were sent for pathological examination, which was performed according to the seventh edition of the American Joint Committee on Cancer TNM staging system, as previously described [17].

Statistics

Pearson's χ^2 test and Fisher's exact test were used to compare categorical variables, and analysis of variance was used to compare continuous variables. Survival curves were estimated using the Kaplan–Meier method and were compared using the log-rank test. Multivariate analysis was performed using the Cox regression model. A p value <0.05 was considered significant. All calculations were performed using SPSS 17.0 software.

Table 1 Characteristics of patients in the open and thoracoscopic groups

	Open ($n = 63$)	Thoracoscopic ($n = 66$)	p value
Age (years), mean ± SD	60 ± 11.3	58.8 ± 10.4	0.533
Sex			0.939
Male	58 (92.1 %)	61 (92.4 %)	
Female	5 (7.9 %)	5 (7.6 %)	
Tumor size (cm, mean ± SD)	4.3 ± 2.4	4.0 ± 2.1	0.36
Tumor invasion depth			0.352
pT1/ypT0/ypT1	15/4/0 (23.8 %)	24/3/2 (36.4 %)	
pT2/ypT2	12/6 (19 %)	14/2 (21.2 %)	
pT3/ypT3	33/4 (52.4 %)	25/2 (37.9 %)	
pT4/ypT4	3/0 (4.8 %)	3/1 (4.5 %)	
Nodal involvement			0.134
pN0/ypN0	31/8 (49.2 %)	36/7 (54.5 %)	
p1N/ypN1	15/2 (23.8 %)	18/0 (27.3 %)	
pN2ypN2	12/3 (19 %)	12/3 (18.2 %)	
pN3ypN3	5/1 (7.9 %)	0/0 (0 %)	
Distant metastasis			0.532
M0	61 (96.8 %)	65 (98.5 %)	
M1	2 (3.2 %)	1 (1.5 %)	
Stage			0.246
Stage 0/I	13 (20.6 %)	16 (24.2 %)	
Stage II	20 (31.7 %)	28 (42.4 %)	
Stage III/IV	30 (47.6 %)	22 (33.3 %)	
Differentiation			0.163
Well	4 (6.8 %)	7 (11.1 %)	
Moderate	53 (89.8 %)	49 (77.8 %)	
Poor	2 (3.4 %)	7 (11.1 %)	
Location			0.931
Upper third	9 (14.3 %)	11 (16.7 %)	
Middle third	36 (57.1 %)	37 (56.1 %)	
Lower third	18 (28.6 %)	18 (27.3 %)	
Margin status			0.962
Not involved (R0 resection)	61 (96.8 %)	64 (97.0 %)	
Involved (R1 resection)	2 (3.2 %)	2 (3 %)	
Total LN (mean ± SD)	25.9 ± 15.3	28.3 ± 16.6	0.39
Neoadjuvant CCRT			0.302
No	49 (77.8 %)	56 (84.8 %)	
Yes	14 (22.2 %)	10 (15.2 %)	
Adjuvant CCRT			0.484
No	41 (65.1 %)	39 (59.1 %)	
Yes	22 (34.9 %)	27 (40.9 %)	

SD standard deviation, *Total LN* total number of harvested lymph nodes, *CCRT* concurrent chemoradiation therapy

Results

The characteristics of 63 (including 2 cases of conversion to thoracotomy) and 66 patients undergoing open and thoracoscopic esophagectomy for ESCC, respectively, are shown in Table 1. These two groups did not differ with regard to background characteristics. The age and sex distributions of these two groups were comparable. The two groups were matched with regard to pathological variables, including TNM stage, tumor differentiation, location, surgical margin status, and the number of total harvested lymph nodes. Pulmonary metastasis ($n = 2$) and hepatic metastasis ($n = 1$) were found incidentally during surgery in three patients. The percentages of patients receiving neoadjuvant or adjuvant treatments also were similar in these two groups. Complete remission of the primary tumor (ypT0) after neoadjuvant chemoradiation was noted in seven (7/24, 29.2 %) patients (true pCR rate [ypT0N0] was 20.8 % [5/24]).

Comparison of perioperative outcomes between the open and thoracoscopic groups is shown in Table 2. Operative time was longer in the thoracoscopic group (510.9 ± 121.3 min) than in the open group (460.5 ± 92.4 min; $p = 0.021$). With regard to postoperative complications, the frequencies of pneumonia ($p = 0.028$) and wound complication (e.g., infection, blister formation) ($p = 0.013$) were significantly lower in the thoracoscopic group. Overall, the ICU stay was <3 days in 40 (31 %) patients and <6 days in more than 80 % patients (104/129). Patients undergoing thoracoscopic esophagectomy also had a significantly shorter intensive care unit (ICU) stay (5.0 vs. 8.1 days, $p = 0.032$). We believe that the difference was due to that patients underwent thoracoscopic esophagectomy weaned from ventilator more quickly.

With regard to oncologic outcomes, the open and thoracoscopic groups were comparable in terms of the total number of harvested lymph nodes and the percentage patients undergoing R0 resection. The mean (median) follow-up periods were 24.8 ± 17.4 (21.0) and 23.0 ± 13.2 (24.0) months in the open and thoracoscopic groups ($p = 0.489$), respectively. Tumor recurrence occurred in 39.5 % (47/119) of the patients. The median time to recurrence was 9 months (9 and 11 months in the open and thoracoscopic groups, respectively). Table 3 presents the patterns of recurrence in both groups. Mediastinal lymphadenopathy was the most common type of locoregional recurrence in both groups. With regard to distant recurrence, the lungs were the most common site of recurrence. The open and thoracoscopic groups did not differ with respect to individual sites of recurrence.

In the open and thoracoscopic groups, the 1-year OS rates were 69.3 and 82.8 %, respectively; the 3-year OS rates were 47.6 and 70.9 %, respectively; the 1-year DFS rates were 48.3 and 76.7 %, respectively; and the 3-year DFS rates were 35.0 and 62.4 %, respectively. Kaplan–Meier analysis showed that patients in the thoracoscopic group had significantly better OS and DFS than those in the open group (Fig. 1, $p = 0.031$ for OS; $p = 0.007$ for DFS). However, on stratification of patients according to stage (stage I/II disease, Fig. 2a, c; stage III/IV disease, Fig. 2b, d), no significant survival difference was noted between the open and thoracoscopic groups. Nevertheless, nonsignificant trends toward better outcomes in the thoracoscopic group were noted in stage-specific survival analysis. In multivariate analysis, the survival impact of surgical techniques was compared after adjusting for baseline characteristics (Table 4). The T and N stages remained significant prognostic factors. Patients with T3/4 stages had significant worse OS than those with T1/2 stages [hazard ratio (HR) 1.926, $p = 0.023$]. Patients with N2/3 stages also had significantly worse OS and DFS than those without nodal

Table 2 Perioperative outcomes of patients in the open and thoracoscopic groups

	Open ($n = 63$)	Thoracoscopic ($n = 66$)	p value
Operation time (min), mean ± SD	460.5 ± 92.4	510.9 ± 121.3	0.021*
Blood loss (ml), mean ± SD	615.4 ± 591.6	462.4 ± 467.8	0.129
Postoperative complications			
Effusion	8 (12.7 %)	8 (12.1 %)	0.921
Empyema	4 (6.3 %)	2 (3 %)	0.371
Pneumonia	16 (25.4 %)	7 (10.6 %)	0.028*
Chylothorax	3 (4.8 %)	4 (6.1 %)	0.745
Wound complication	8 (12.7 %)	1 (1.5 %)	0.013*
Leakage	19 (30.2 %)	18 (27.3 %)	0.717
ICU stay (day, mean ± SD)	8.1 ± 9	5 ± 7.1	0.032*
Surgical mortality	5 (7.9 %)	5 (7.6 %)	0.939

SD standard deviation, *ICU* intensive care unit

* $p < 0.05$

Table 3 Recurrence sites in patients in the open and thoracoscopic groups

	Open ($n = 58$)	Thoracoscopic ($n = 61$)	p value
Locoregional recurrence			
Mediastinal lymph node	10 (15.9 %)	4 (6.1 %)	0.071
Abdominal lymph node	4 (6.3 %)	1 (1.5 %)	0.153
Cervical lymph node	3 (5.2 %)	2 (3.0 %)	0.607
Anastomosis	1 (1.6 %)	2 (3.0 %)	0.589
Distant metastasis			
Lung	10 (17.2 %)	4 (6.6 %)	0.071
Malignant pleural effusion	6 (10.3 %)	2 (3.0 %)	0.124
Liver	3 (4.8 %)	2 (3.0 %)	0.607
Bone	5 (7.9 %)	1 (1.5 %)	0.082
Others (brain, skin, adrenal gland)	1 (1.6 %)	2 (3.0 %)	0.589

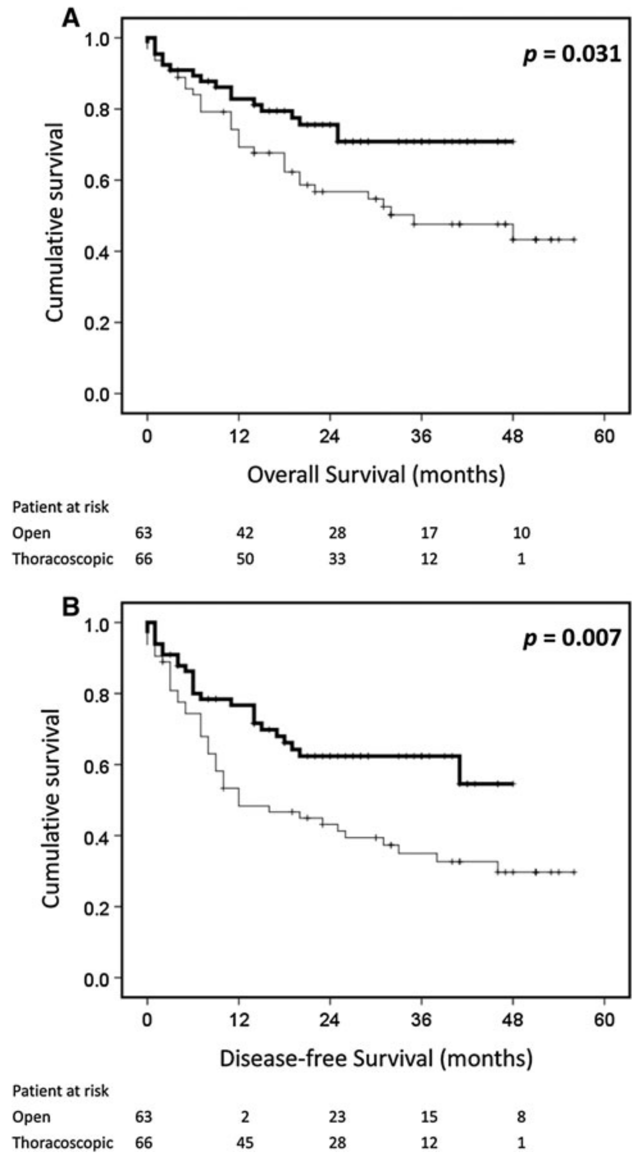

Fig. 1 OS and DFS of patients in the open and thoracoscopic groups. Patients in the thoracoscopic group had better OS (**a**) and DFS (**b**) than those in the open group (*thick line* thoracoscopic group, *thin line* open group)

involvement (for OS: HR: 2.612, $p = 0.004$; for DFS: HR: 2.919, $p = 0.004$). However, the surgical technique did not have significant impact on patient outcome. Although there was a trend toward better OS (HR 0.626) and DFS (HR 0.68) in patients undergoing thoracoscopic esophagectomy, no statistical significance was reached.

Discussion

Since endoscopic esophagectomy was first reported by Cuschieri et al. [4–15, 21] in 1992, MIE has attracted much attention because of its advantages, including reduced intraoperative blood loss, better preservation of pulmonary function, fewer complications, and shorter hospital/ICU stays. With regard to the impact of MIE on patient prognosis, many reports showed that OS was similar for MIEs and open esophagectomy [4, 5, 7, 8, 11, 22, 23]. However, some studies reported nonsignificant trends toward better OS in the MIE group. For example, Lazzarino et al. [15] analyzed the outcomes of esophagectomy in England during a period of 12 years. They found that patients undergoing MIE had better 1-year survival rates than those undergoing open procedures (odds ratio 0.68, $p = 0.058$). Few studies use DFS for oncologic outcome evaluation. On comparing thoracoscopic-assisted esophagectomy with open transthoracic esophagectomy, Thomson et al. [24] reported a trend toward better DFS and a significantly better “regional” recurrence-free survival in the thoracoscopic-assisted esophagectomy group. In accordance with Thomson’s report, a trend toward better DFS was noted in the MIE group in Schoppmann’s study. The 3-year DFS rates were 59 and 50 % in the MIE and open esophagectomy groups, respectively, but this difference was not significant ($p = 0.112$) [9]. However, these two studies included data from either an adenocarcinoma-predominant database or from cohorts of patients with mixed squamous cell carcinoma and adenocarcinoma. Therefore, these results may not be applicable to the Asian population, in which squamous cell carcinoma is the most frequent histology type. Studies focusing on squamous cell carcinoma histology are limited. Only one study from Japan indicated that 5-year DFS was slightly better in the thoracolaparoscopic esophagectomy group than in the conventional open esophagectomy group, with borderline significance ($p = 0.07$) [25]. Although no statistical significance was achieved, the survival curves of these three studies consistently showed better DFS in the MIE group. To further elucidate the possible merit of MIE with regard to DFS, we analyzed the prognosis of patients with esophageal cancer in our hospital. Patients undergoing thoracoscopic esophagectomy showed better OS and DFS than those undergoing open esophagectomy. Although the difference in survival did not reach statistical significance after adjusting for disease stage, survival rates tended to be higher in the HMIE group, indicating that oncologic efficacy was not compromised by the application of endoscopic techniques in esophagectomy. In recurrence pattern analysis, distant metastasis was noted as the first recurrence in 67.7 and 62.5 % of patients after open and thoracoscopic esophagectomy, respectively. Our results were similar with those of previous reports. In Thomson’s study, most recurrences were distant recurrences. In total, 81 and 82 % of recurrences in the thoracoscopic-assisted esophagectomy and open transthoracic esophagectomy groups, respectively,

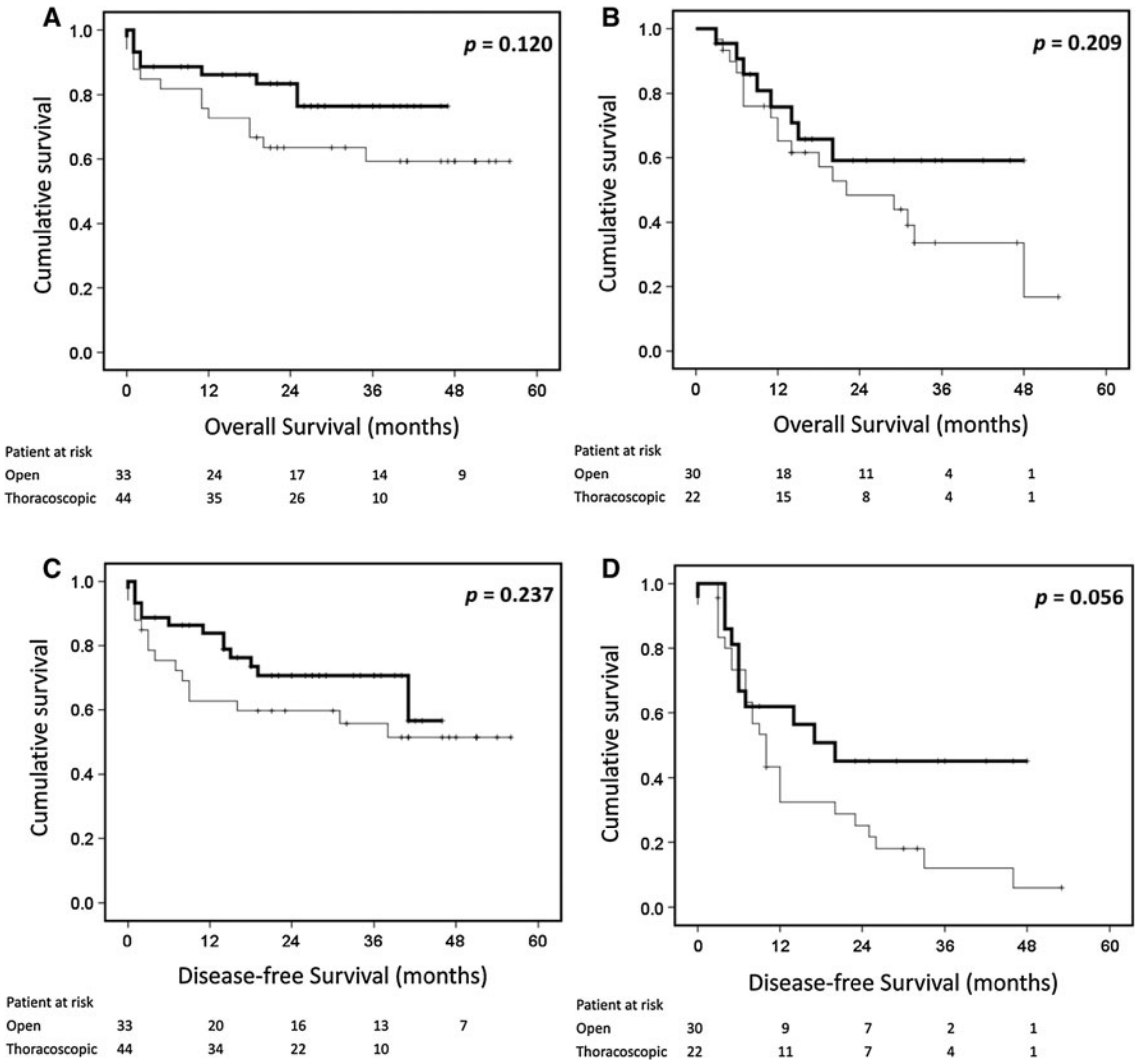

Fig. 2 Stage-specific OS and DFS of patients in the open and thoracoscopic groups. Although statistical significance was not achieved, patients with stage I/II (**a**) and stage III/IV (**b**) disease in the thoracoscopic group tended to have better OS. DFS also tended to be better in patients with stage I/II (**c**) and stage III/IV (**d**) disease who had undergone thoracoscopic esophagectomy, although this trend was not statistically significant (*thick line* thoracoscopic group, *thin line* open group)

were distant recurrences [24]. Although no significant difference in the failure pattern was noted between the open and thoracoscopic groups in our study, the frequency of mediastinal lymph node recurrence, lung metastasis, and malignant pleural effusion was slightly higher in the open group. A possible explanation is the magnified vision afforded by thoracoscopy, which facilitates more delicate mediastinal dissection and better tumor clearance. Therefore, despite similar stage distribution, R0 resection, and nodes sampled, the endoscopic techniques could remove more unrecognized tumor cells, or tissue harboring micrometastasis, and in turn improve patient survival. However, this effect may be very trivial and we believe that a study with larger patient number is needed to confirm this viewpoint. Another possible explanation for better outcome in thoracoscopic group may be that because endoscopic techniques provides earlier and faster recovery from surgical trauma, patients resume to normal activity in a shorter period and are more likely to be physically capable to receive further treatments, either adjuvant treatment or additional treatment for disease recurrence. Similar observation also has been reported in lung cancer patients that application of endoscopic techniques may improve the delivery of additional treatments [26].

Our study has some limitations and shortcomings. First, because of the retrospective design and relative small sample size, bias related to unequal patient distribution was unavoidable. The selection of open or thoracoscopic approaches was not randomized and was affected by social disparities; patients without private insurance would refuse

Table 4 Survival impact of surgical approaches after adjusting for age, sex, tumor stage, and treatment modality

Variables	DFS			OS		
	HR	95 % CI	p value	HR	95 % CI	p value
Age[a]	1.007	0.981–1.034	0.589	1.005	0.973–1.037	0.779
Sex						
Male ($n = 119$)	1	–	–	1	–	–
Female ($n = 10$)	1.702	0.711–4.074	0.232	1.507	0.492–4.614	0.472
T stage						
T1/2 ($n = 65$)	1	–	–	1	–	–
T3/4 ($n = 64$)	1.926	1.094–3.392	0.023**	1.6	0.835–3.068	0.157
N stage						
N0 ($n = 67$)	1	–	–	1	–	–
N1 ($n = 33$)	1.046	0.532–2.056	0.897	1.128	0.498–2.554	0.773
N2/3 ($n = 29$)	2.612	1.368–4.988	0.004**	2.919	1.403–6.071	0.004**
Neoadjuvant CCRT						
No ($n = 105$)	1	–	–	1	–	–
Yes ($n = 24$)	1.605	0.76–3.391	0.215	2.11	0.919–4.846	0.078
Adjuvant CCRT						
No ($n = 80$)	1	–	–	1	–	–
Yes ($n = 49$)	0.72	0.378–1.371	0.318	0.606	0.275–1.335	0.214
Surgical techniques						
Open ($n = 63$)	1	–	–	1	–	–
Thoracoscopic ($n = 66$)	0.626	0.369–1.062	0.083	0.68	0.367–1.262	0.222

CCRT concurrent chemoradiation therapy

[a] Factors examined as continuous variable

** $p < 0.05$

the thoracoscopic instruments, which were not paid by the National Health Insurance. The insurance status also affects lung cancer treatment in the literature [27]. Second, the proportion of patients receiving neoadjuvant chemoradiation was relatively low; only 18.6 % of patients received neoadjuvant chemoradiation. Since 2010, we have adopted a multidisciplinary approach per the NCCN guidelines. Consequently, a greater number of patients underwent endoscopic ultrasonography during the staging workup, and a higher proportion of patients received neoadjuvant chemoradiation before surgical resection. Whether the effect of minimally invasive surgery differs for primary resection cases and cases of resection after neoadjuvant therapy remains unknown. In addition, patient survival may have been enhanced because of accurate staging and trimodal treatment. In current study, the OS was 76.1 and 57.9 % at 1 and 3 years, which was similar to that in the worldwide esophageal cancer collaboration (WECC) database, i.e., OS was 78, 42, and 31 % at 1, 5, and 10 years [28]. Tumor recurrence occurred in 39.5 % (47/119) of the patients. The median time to recurrence was 9 months (mean 12.8 months), which was compatible with reported in the literature [29–31]. Third, several different techniques for performing esophagectomy have been described in the literature. In general, these procedures entail thoracoscopic esophagectomy performed in the prone or lateral position, followed by open, hand-assisted, or laparoscopic gastric tube mobilization. Alternatively, laparoscopic gastric mobilization followed by open transthoracic or thoracoscopic esophagectomy has been used. Furthermore, anastomoses can be cervical (McKeown) or intrathoracic (Ivor-Lewis). The applicability of our results using thoracoscopic esophagectomy combined with laparotomy for all types of MIE is not certain.

Conclusions

Thoracoscopic esophagectomy has advantages over open esophagectomy in terms of fewer postoperative complications and shorter ICU stay, findings that are in agreement with those of previous reports. With regard to oncologic efficacy, the outcomes of open and thoracoscopic esophagectomy were similar in terms of the total number of harvested lymph nodes and the percentage patients undergoing R0 resection. Furthermore, the prognosis of ESCC patients undergoing thoracoscopic esophagectomy is at least comparable to that of patients undergoing open procedures in terms of OS and DFS. Our experience could encourage thoracic surgeons to adopt this procedure for the treatment of ESCC.

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