Original Article

A comparison of two methods of lymph node dissection along the left recurrent laryngeal nerve in McKeown minimally invasive esophagectomy

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Background: Lymph nodes dissection in esophagectomy is an essential procedure for radical resection, which can not only provide more accurate staging but may also improve survival, while it is technically challenging and may lead to recurrent laryngeal nerve (RLN) paralysis. Numerous efforts have been directed to achieve the dissection of more LNs around the RLN and to lower the incidence of RLN palsy, including Bascule method and modified Bascule method. On this basis, we modified and applied a novel method which involves the en bloc dissection of lymph nodes dissection along the left RLN in McKeown minimally invasive esophagectomy (MIE).

Methods: A total of 244 consecutive cases of lymphadenectomy along the left RLN during McKeown MIE at our institution between January 2018 and August 2021 were retrospectively analyzed. The cases were divided into two groups based on the methods of lymphadenectomy along the left RLN: 77 cases received the conventional method (CM group) and 167 cases received the novel method (NM group). The surgical outcomes, especially the impact of surgical proficiency on the outcomes of lymphadenectomy along the left RLN, were assessed and compared between the two groups.

Results: Demographic data of the two cohorts were similar. The number of harvested lymph nodes (LNs) (total/abdomen/left RLN) in the NM group was markedly higher than that in the CM group (32 *vs.* 27, P=0.006; 11 *vs.* 9, P=0.038; 3 *vs.* 2, P=0.044). However, the number of harvested LNs from the chest or right RLN was not significantly different in the two groups. The hoarseness rate was 1.8% in the NM group, which was slightly but not notably lower than that of the CM group (1.8% *vs.* 2.6%, P=0.681). The incidence of LN metastasis along the left RLN was 13.9%, 15.6%, and 13.2% in the whole cohort, CM group, and NM group, respectively.

Conclusions: Our novel method not only increased the number of LN dissections along left RLN but also slightly reduced the incidence of hoarseness. Therefore, this novel method of lymphadenectomy along the left RLN during McKeown MIE is safe and reliable.

Keywords: Minimally invasive esophagectomy (MIE); lymph node dissection; recurrent laryngeal nerve (RLN); hoarseness

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Introduction

Esophageal cancer is one of the most common malignant tumors around the world, ranking seventh in terms of incidence and sixth in terms of mortality worldwide (1,2). Unfortunately, more than 50% of esophageal cancer cases occur in China, making it the fifth most common malignant tumor and the fourth leading cause of cancer-related death in the country (3,4). In Western countries, the main pathological type of esophageal cancer is adenocarcinoma. In contrast, in China, more than 90% of esophageal cancers are squamous cell carcinomas that are most commonly located in the thoracic esophagus (4). Radical esophagectomy combined with neoadjuvant therapy has been considered the mainstream and effective treatment strategy for esophageal cancer (5). However, due to the high complication and mortality rates of open esophagectomy (OE), minimally invasive esophagectomy (MIE) has been widely accepted since the 1990s owing to its advantages, including less surgical trauma, fewer complications, and lower mortality rate (5-9).

Although neoadjuvant therapy has been commonly applied and demonstrated to increase the survival rate of esophageal cancer patients, the overall survival rate is still fairly low (6,7,10). Esophageal cancer presents with bidirectional, skipping lymph node (LN) metastasis including to the neck, mediastinum, and abdomen areas. Therefore, LN metastasis is one of the most important prognostic factors leading to the poor prognosis of esophageal cancer (10). It has been reported that the metastasis rate of bilateral laryngeal LNs was the highest in thoracic esophageal cancer, and it may even exceed 10% in clinical N0 superficial thoracic esophageal cancer (11). To improve survival and provide adequate staging, a radical approach of lymphadenectomy is necessary, which involves the dissection of abdominal and thoracic LNs, as well as the dissection of the LNs around the bilateral recurrent laryngeal nerve (RLN) (12). However, completely dissecting the LNs around the RLN is challenging due to the complex anatomy, and the narrow space of the upper mediastinum not only increases the difficulty of dissection and prolongs the surgical learning curve but it can also easily lead to RLN injury (13).

Numerous efforts have been directed to achieve the dissection of more LNs around the RLN and to lower the incidence of RLN palsy. Noshiro *et al.* adopted the prone position in thoracoscopic esophagectomy to provide enhanced exposure and surgical vision around the left RLN (14). Oshikiri *et al.* proposed a method of LN dissection along the left RLN during prone esophagectomy, known as the Bascule method, which focused on the anatomical concept of the esophageal mesenteriolum (15). Based on these methods, Zhang *et al.* introduced a modified Bascule method to completely remove the esophageal mesenteriolum to skeletonize the left RLN (16). The results showed that this modified Bascule method could obtain more lymph nodes along the left RLN. The above results showed that the improved method gradually improved the efficiency of lymph node dissection, while maintaining a relatively acceptable rate of recurrent laryngeal nerve injury. Lessons had been learned from the above methods and more efforts could be done. To dissect LNs along the left RLN more thoroughly with a lower risk of nerve palsy, we modified the previously reported methods and applied a novel method, which involves the en bloc dissection of LNs along the left RLN during McKeown MIE in the semi-prone position. Herein, we retrospectively reviewed and analyzed 244 cases of patients who underwent lymphadenectomy along the left RLN during McKeown MIE using the aforementioned novel method versus a conventional method. We present the following article in accordance with the STROBE reporting checklist (available at https://jgo.amegroups.com/article/view/10.21037/jgo-22-1273/rc).

Highlight box

Key findings

- The novel method of lymph node dissection along the left RLN in the semi-prone position during McKeown MIE is safe and reliable.

What is known and what is new?

- Many efforts have been directed to dissect more LNs around the RLN and to lower the incidence of RLN palsy.
- To dissect LNs along the left RLN more thoroughly with a lower risk of nerve palsy, we modified the previously reported methods and applied a novel method, which involves the *en bloc* dissection of LNs along the left RLN during McKeown MIE in the semi-prone position.

What are the implications, and what should change now?

- Although the LNs also be removed using the conventional method, the left RLN is not fully visible. Meanwhile, our novel lymphadenectomy along the left RLN not only increased the number of LNs but also decreased the incidence of hoarseness.

Methods

Patients

This was a retrospective study. Patients who underwent McKeown MIE with lymphadenectomy along left RLN from January 2018 through August 2021 were selected. In total, 244 consecutive cases were enrolled in this study. All patients were diagnosed pathologically with esophageal cancer by electronic esophagogastroduodenoscopy and clinical tumor-node-metastasis (TNM) staging based on positron emission tomography-computed tomography (PET-CT), cervical and supraclavicular B-ultrasound, chest and abdominal contrast CT, or endoscopic ultrasonography. All patients were evaluated by a multidisciplinary expert team and given personalized treatment plans according to the treatment guidelines of the National Comprehensive Cancer Network (NCCN) and the Guidelines for the Diagnosis and Treatment of Esophageal Carcinoma of the Chinese Medical Association. All surgical operations were performed by one surgical team with expertise in OE and MIE. All operations were performed by one surgical team, which was proficient in OE and MIE.

Based on the two different techniques of lymphadenectomy along the left RLN, the patients were assigned into the following two groups: 77 patients received the conventional method (CM group) from January 2018 to June 2019, and 167 patients received the novel method (NM group) from 2019 July to August 2021. Hoarseness was subjectively assessed according to the auditory impression by the otolaryngologist. The study was conducted in accordance with the Declaration of Helsinki (as revised in 2013). Written informed consent was obtained from each participant. The research protocol of this clinical study was approved by the Ethics Committee of the Sir Run Run Shaw Hospital (No. 20220314-33).

Thoracic procedure and trocar locations

The patients were placed in a left semi-prone position with single-lumen endotracheal intubation, and artificial carbon dioxide (CO_2) pneumothorax was established at a pressure of 6–8 mmHg. Four ports were distributed in the right thorax. A 12-mm port was located at the seventh intercostal space in the mid-axillary line for the camera, and another 12-mm port for the assistant was placed at the tenth intercostal space in the subscapular line. Two additional ports were used for the operation by the surgeon: a 5-mm port was located at the seventh intercostal space in the subscapular line and a 12-mm port was placed at the fifth intercostal space in the mid-axillary line.

Procedure of the novel method for lymphadenectomy along the left RLN

After disconnecting the azygos arch, the esophagus was mobilized from the upper mediastinum to the diaphragm hiatus while protecting the thoracic duct. A sling through the port was then used to suspend the esophagus forward to facilitate the dissection of LNs. The esophageal suspension method not only promotes the continuous traction of the esophagus in the direction of the incision but also moves the right lung forward (*Figure 1A*). Accordingly, the posterior mediastinum space was expanded to provide a larger operating space.

After dissecting the subcarinal LNs, the left main trachea and the lower part of the trachea were rotated forward with an attractor sucking a cotton swab to explore the tracheoesophageal groove. Under proper suspension and good anti-traction, the surface of the tracheoesophageal groove containing LNs, the left RLN, and fatty tissue was well-exposed. Starting from the area below the aortic arch, the anterior edge of the connective tissue was freed along the left main bronchus and then along the proximal direction of the trachea. The tracheal side of the connective tissue in the tracheal esophageal groove was then completely detached (*Figure 1B*). The surgeon lifted the connective tissue so that it detached from the trachea and expanded the three-dimensional connective tissue into a two-dimensional structure, which we called a two-dimensional membrane. In this two-dimensional membrane, the left RLN, LNs, and vessels were clearly displayed (*Figure 1C*).

Next, the surgeon separated the LNs in the two-dimensional membrane using forceps by a combination of blunt and sharp methods, starting at the root of the left RLN and moving from bottom to top along the left RLN (*Figure 1D*). Meanwhile, an ultrasonic knife or a regular knife was used to dissect the fibrous connective tissue and the vessels around the LNs with careful identification and protection of the nourishing vessels of the RLN (*Figure 1E*). If the vision was affected by bleeding, a small gauze strip was temporarily used to stop the bleeding and to preserve the more nourishing blood vessels around the left RLN. The left RLN was identified and the nerve sheath was protected. The procedure of en bloc lymphadenectomy along the left RLN was then completed, and the left inferior thyroid artery was occasionally visible (*Figure 1F*).

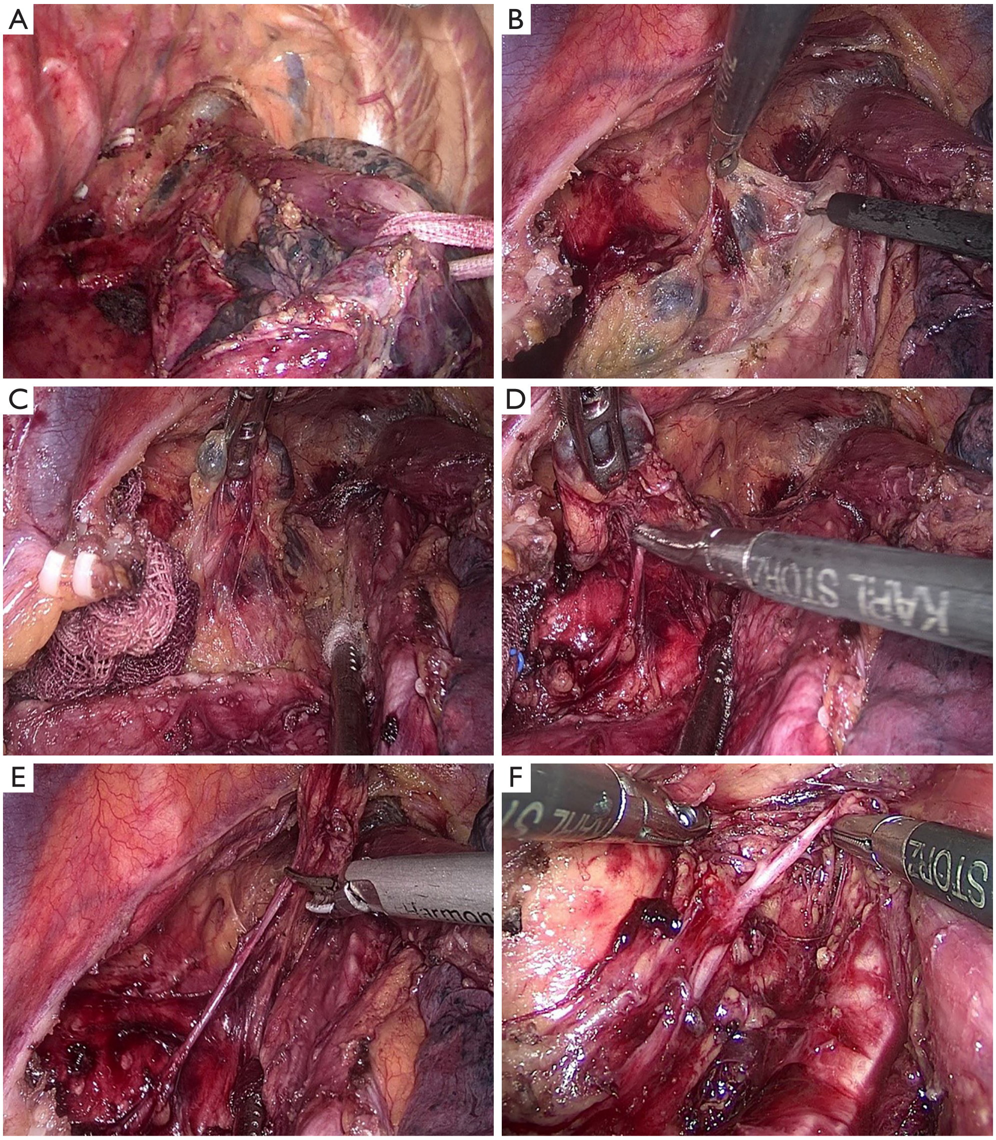

Figure 1 Illustration of lymphadenectomy along the left RLN with the novel method. (A) The esophagus was suspended with a sling. (B) The trachea was rotated forward with an attractor sucking a cotton swab, and the anterior edge of connective tissue was freed along the left main bronchus and the trachea. (C) The connective tissue in the narrow space was expanded into a two-dimensional membrane, and the lymph nodes, left RLN, and vessels were clearly exposed. (D) Forceps were used to bluntly separate the lymph nodes at the root of the left RLN, and the initial part of the left RLN was visible and protected. (E) The vessels around the lymph nodes were coagulated and severed using an ultrasonic knife; the nourishing vessels of the RLN were identified and retained. (F) The *en bloc* lymphadenectomy along the left RLN was completed while the left inferior thyroid artery was occasionally visible. RLN, recurrent laryngeal nerve.

Procedure of the conventional method for lymphadenectomy along the left RLN

After mobilizing and suspending the esophagus, the subcarinal LNs were dissected using the same procedure as that in the NM group described above. Tissues including the left RLN and LNs in the left tracheoesophageal groove were exposed, and the surgeon bluntly separated the tissues using forceps to separate the LNs from the left RLN. Subsequently, the LNs were dissected by the surgeon after separating them from the middle section of the left RLN using a blunt and sharp motion with his left hand while holding the LNs with his right hand.

Statistical analysis

The demographic parameters of the patients were expressed using descriptive statistics. The continuous variables were expressed as the mean ± standard deviation for normally distributed data or as the median (interquartile range) for non-normally distributed variables. An independent sample *t*-test was used for comparison between the two groups, while the Mann-Whitney U test and Pearson's χ^2 test were performed to examine the differences between the two groups. Statistical analysis was completed using SPSS® version 20 (SPSS, Inc., Chicago, IL, USA), with P<0.05 indicating a statistically significant difference.

Results

Demographic parameters

A total of 244 cases were included in this study. Among them, 77 cases of LN dissection around the left RLN were performed via the conventional method (CM group), and 167 cases of LN dissection around the left RLN were carried out using the novel method (NM group). The demographic characteristics of the patients, neoadjuvant therapy, and tumor characteristics of the entire cohort are presented in *Table 1*. There were no significant differences in age, body mass index (BMI), smoking and drinking history, and rate of comorbidities between the two groups (P>0.05). However, the percentages of neoadjuvant chemotherapy and neoadjuvant immunotherapy were significantly higher in the NM group compared to those in the CM group (chemotherapy: 28.7% *vs.* 15.6%, P=0.027; immunotherapy: 8.4% *vs.* 0, P=0.009, respectively). Histological analysis indicated that the majority of the cancers were squamous cell carcinomas.

Surgical outcomes and pathological characteristics

The perioperative outcomes and pathological findings are shown in *Table 2*. The median operation time was 225 minutes in the CM group and 240 minutes in the NM group. The median intraoperative blood loss was 100 mL in both groups. The percentage of patients who underwent ligation of the thoracic duct was significantly higher in the CM group (41.6%, 32/77) than that in the NM group (23.4%, 39/167, P=0.004). The median number of harvested LNs in total, from the abdomen, or from the left RLN was markedly higher in the NM group than that in the CM group (P=0.006 in total, P=0.038 from the abdomen, P=0.044 from the left RLN, *Table 2*). However, the median number of harvested LNs from the chest or right RLN was not significantly different between the two groups (P>0.05, *Table 2*). In addition, there were no significant differences between the two groups in terms of postoperative hospital stay, TNM stage, perineural invasion, or vascular invasion.

Postoperative complications

The postoperative complications of the two groups are presented in *Table 3*. There were no significant differences in postoperative complications between the groups except for the incidence of wound infection, which was substantially higher (9.1%, 7/77) in the CM group compared to the NM group (0.6%, 1/167, P=0.001, *Table 3*). The incidence of anastomotic leakage was 2.6% in the entire cohort, and it was slightly but not significantly higher in the CM group (5.2%, 4/77) compared to the NM group (1.2%, 2/167, P=0.061). All cases of anastomotic leakage were healed using non-surgical management. The incidence of hoarseness was not significantly different between the groups (2.6% *vs.* 1.8%, P=0.681), and all cases recovered within 6 months after surgery with conservative treatment.

Perioperative death occurred in one of the NM group patients who suffered from severe pneumonia and died of respiratory failure 30 days after surgery (*Table 3*). Although the incidences of pleural effusion (9.6%, 16/167) and intensive care unit (ICU) stay (6.0%, 10/167) were slightly (but not significantly) higher in the NM group compared to that of the CM group (pleural effusion: 7.8%, 6/77, P=0.650; ICU stay: 2.6%, 2/77, P=0.255), the incidence of other comorbidities was very low (*Table 3*).

LN metastasis status

The incidence of LN metastasis in the two groups is shown in *Table 4*. In this study, it was found that 131 out of 244 (53.7%) patients with esophageal cancer experienced LN metastasis. Specifically, the incidence of total LN metastasis was 50.7% (39/77) in the CM group and 55.1% (92/167) in the NM group, which was not significantly different. Similarly, there was no marked difference between the two groups in terms of the incidence of left RLN LN metastasis [CM: 15.6% (12/77) *vs.* 13.2% (22/167)].

Table 1 Demographic and tumor characteristics of the included patients

Characteristic	CM group (n=77)	NM group (n=167)	P value
Age (years)*	64.99±7.20	64.80±7.86	0.861
Sex, n (%)			0.276
Male	66 (85.7)	151 (90.4)	
Female	11 (14.3)	16 (9.6)	
BMI (kg/m^2)*	22.28±3.28	21.87±2.94	0.320
History of smoking	36 (46.8)	59 (35.3)	0.089
History of drinking	32 (41.6)	66 (39.5)	0.729
ASA, n (%)			0.336
I	1 (1.3)	0 (0.0)	
II	75 (97.4)	165 (98.8)	
III	1 (1.3)	2 (1.2)	
Comorbidity, n (%)			
Hypertension	25 (32.5)	58 (34.7)	0.729
Diabetes mellitus	3 (3.9)	7 (4.2)	0.914
Cardiovascular disease	6 (7.8)	13 (7.8)	0.998
Obstructive lung disease	4 (5.2)	5 (3.0)	0.397
Cerebrovascular disease	2 (2.6)	10 (6.0)	0.255
Neoadjuvant chemotherapy, n (%)	12 (15.6)	48 (28.7)	0.027$^{\#}$
Neoadjuvant radiotherapy, n (%)	2 (2.6)	1 (0.6)	0.188
Neoadjuvant immunotherapy, n (%)	0 (0.0)	14 (8.4)	0.009$^{\#}$
Endoscopic submucosal dissection, n (%)	2 (2.6)	3 (1.8)	0.681
Histological type, n (%)			0.031$^{\#}$
Squamous cell carcinoma	73 (94.8)	166 (99.4)	
Adenocarcinoma	1 (1.3)	1 (0.6)	
Others	3 (3.9)	0 (0.0)	
Tumor location, n (%)			0.652
Upper	5 (6.5)	7 (4.2)	
Middle	30 (39.0)	61 (36.5)	
Lower	42 (54.5)	99 (59.3)	

*, values were expressed as mean ± SD; $^{\#}$, statistically significant difference. ASA, American Society of Anesthesiologists; BMI, body mass index; CM, conventional method; NM, novel method; SD, standard deviation.

Discussion

Currently, neoadjuvant therapy combined with esophagectomy and the dissection of potentially metastatic LNs remains the essential treatment for esophageal cancer (7). Previous studies have demonstrated that compared to OE, MIE has the advantages of less surgical trauma, fewer complications, lower mortality, as well as similar oncological outcomes (5-9,13). Consequently, various MIEs have been widely applied and performed in most academic centers. The submucosa of the esophagus contains a rich

Table 2 Outcomes of surgery and pathological features of the tumors in the two groups

Outcomes	CM group (n=77)	NM group (n=167)	P value
Operative time (min)*	225 (207.5, 280)	240 (215, 265)	0.638
Intraoperative blood loss (mL)*	100 (50, 100)	100 (50, 100)	0.773
Ligation of thoracic duct, n (%)	32 (41.6)	39 (23.4)	0.004#
Restore fluid diet time (d)*	9 (8, 10.5)	9 (9, 11)	0.005#
Postoperative hospital stay (d)*	11 (10, 14)	11 (10, 13)	0.252
Total lymph node dissection (n)*	27 (21.5, 36)	32 (25, 41)	0.006#
Chest lymph node dissection (n)*	18 (13, 23.5)	20 (14, 25)	0.119
Abdomen lymph node dissection (n)*	9 (6.5, 14)	11 (7, 16)	0.038#
Lymph node dissection around right RLN (n)*	3 (1.5, 5)	3 (1, 5)	0.988
Lymph node dissection around left RLN (n)*	2 (1, 4)	3 (1, 6)	0.044#
Pathological tumor category, n (%)			0.119
T1	23 (29.9)	43 (25.7)	
T2	10 (13.0)	41 (24.6)	
T3	44 (57.1)	83 (49.7)	
Pathological node category, n (%)			0.546
N0	38 (49.4)	75 (44.9)	
N1	19 (24.7)	50 (29.9)	
N2	17 (22.1)	30 (18.0)	
N3	3 (3.9)	12 (7.2)	
TNM stage, n (%)			0.548
Stage I	25 (32.5)	45 (26.9)	
Stage II	18 (23.4)	35 (21.0)	
Stage III	31 (40.3)	74 (44.3)	
Stage IV	3 (3.9)	13 (7.8)	
Vascular invasion, n (%)	11 (14.3)	31 (18.6)	0.411
Perineural invasion, n (%)	12 (15.6)	27 (16.2)	0.908

*, values were expressed as the median (interquartile range); #, statistically significant difference. RLN, recurrent laryngeal nerve; TNM, Tumor Node Metastasis; CM, conventional method; NM, novel method.

network of longitudinal lymphatic vessels, and therefore, once esophageal cancer has involved the submucosal layer, "skipping metastasis" may occur to the upper mediastinal area far away from the original lesion, including along the bilateral RLN (17). Previous studies have reported metastasis rates of between 20% and 40% in the RLN LN, and even up to 20% in patients with lower esophageal squamous cell cancer (ESCC) (12,18). Therefore, LN dissection in esophagectomy is an essential procedure for radical resection, which can not only provide more accurate staging but may also improve survival (12).

However, complete dissection of LNs around RLN is technically challenging and may lead to RLN paralysis resulting from thermal injury, squeezing, stretching, and nourishing vessel injury. RLN paralysis increases the incidence of postoperative complications, which include (but are not limited to) hoarseness and coughing, aspiration pneumonia, and even acute respiratory distress syndrome,

Table 3 Postoperative complications in the two groups

Outcomes	CM group (n=77)	NM group (n=167)	P value
Anastomotic leakage	4 (5.2)	2 (1.2)	0.061
Hoarseness	2 (2.6)	3 (1.8)	0.681
Wound infection	7 (9.1)	1 (0.6)	0.001#
Pleural effusion	6 (7.8)	16 (9.6)	0.650
Pneumonia	3 (3.9)	12 (7.2)	0.320
Chylothorax	1 (1.3)	1 (0.6)	0.573
Arrhythmia	0 (0.0)	4 (2.4)	0.171
Pneumothorax	2 (2.6)	2 (1.2)	0.424
ICU stay	2 (2.6)	10 (6.0)	0.255
Secondary surgery	1 (1.3)	2 (1.2)	0.947
Liver dysfunction	2 (2.6)	1 (0.6)	0.188
Acute renal dysfunction	0 (0.0)	2 (1.2)	0.335
Pulmonary embolism	0 (0.0)	1 (0.6)	0.496
Death	0 (0.0)	1 (0.6)	0.496

Data are presented as n (%). #, statistically significant difference. ICU, intensive care unit; CM, conventional method; NM, novel method.

Table 4 Lymph node metastasis status in the two groups

Group	Incidence of lymph node metastasis	
	CM group	NM group
Total	50.7% (39/77)	55.1% (92/167)
Left RLN	15.6% (12/77)	13.2% (22/167)

RLN, recurrent laryngeal nerve; CM, conventional method; NM, novel method.

as well as the increased risk of anastomotic leakage and prolonged postoperative hospital stay (13-20). Despite the continuous technological development and equipment updates, the incidence of RLN paralysis is still high, ranging from 2.9% to 69%. In particular, RLN paralysis on the left is more likely to occur compared to the right (12-18). Therefore, we used a novel method that involved en bloc dissection of the LNs in this area with sufficient exposure and precise surgery.

The full exposure of the surgical area is the first priority in LN dissection to reduce complications (21). Thoracoscopy provides a larger surgical field of view, which is more vivid than the field of open surgery. The semi-prone position provides good exposure: not only can the lungs fall forward due to gravity, but also mediastinal tissues can be naturally exposed by the artificial pneumothorax. Furthermore, with the help of single-lumen endotracheal intubation and artificial pneumothorax, the tissue around the esophagus and the gap between the esophagus and trachea are easy to expose and dissect. More importantly, the left semi-prone position can be quickly converted to the left lateral position when emergency open conversion is necessary (12). In this study, by combining the left semi-prone position and esophageal suspension, the trachea was pushed forward by an aspirator with a cotton swab to expose the tracheoesophageal groove, and the LNs around the left RLN were dissected by a blunt dissection method, which reduced damage to the tissue.

There are three important anatomical structures in the narrow space of the upper mediastinum: the left RLN that should be completely protected; the LNs that should be completely removed; and the nourishing vessels of the RLN that should be retained. The above structures are mixed together in a narrow space, complicating LN resection along the left RLN. Compared with the right RLN, the left RLN has a longer course from the aortic arch to the neck, and it is more likely to be damaged during lymphadenectomy. Thus, it is necessary to understand the interrelationship of these three anatomical structures and their anatomical logic. Oshikiri *et al.* (15) proposed the Bascule method as an effective procedure to dissect the LNs along the RLN and introduced the concept of the "esophageal mesenteriolum", which integrated the left RLN, the LNs, and the trachea-esophageal artery in the left upper mediastinum into a two-dimensional membrane. In our procedures, the visual exposure of the field was greatly improved with the suspension of the esophagus and the forward movement of the trachea, and complete lymphadenectomy in this space was performed. This novel approach provided better exposure and greater operating space, and thus, the median number of dissected LNs along the left RLN using this novel method was significantly improved compared to that dissected via the conventional method.

Previous studies have reported the high incidence of LN metastases around bilateral RLNs in thoracic esophageal squamous cell cancer (11,12,14,16,17). Niwa *et al.* (22) found that the rate of LN metastasis to bilateral RLN was 15.8% among 342 patients, Zhang *et al.* (16) demonstrated that the incidence of metastasis to the left RLN LN was 18.6% in the entire cohort of 194 patients, and Tan *et al.* (23) reported that the frequency of LN metastasis along the left

RLN was 8.7%. In our study, the incidence of left RLN LN metastasis was 13.9%, which was similar to the results reported in the aforementioned studies. Moreover, the number of harvested LNs along the left RLN via the novel method in this study was markedly greater than that by the conventional method. Since not all patients with hoarseness underwent laryngoscopy, for the purpose of comparative research in this study, hoarseness was considered to be the main criterion for evaluating RLN palsy. The incidence of hoarseness in the NM group was 1.8%, which was lower than that in the CM group (2.6%); however, the difference was not statistically significant. In addition, all patients with hoarseness recovered within 6 months after surgery with conservative treatment. These results indicated that our novel method was superior to the conventional method in terms of increasing the number of LN dissections along the left RLN without increasing the risk of left RLN injury.

Although LNs could also be removed using the conventional method, the left RLN was not fully visible, and the nourishing vessels were easily damaged. In contrast, the novel method applied in this study has several advantages compared to the conventional method. Firstly, by suspending the esophagus and turning the trachea forward with an attractor sucking a cotton swab, the left tracheal esophagus sulcus was clearly exposed, allowing the surgeon to easily identify and isolate the left RLN so that the LNs were dissected completely and safely. Secondly, without increasing the risk of injury to the left RLN and other complications, including anastomotic leakage and pneumonia, our novel method increased the number of LN dissections along the left RLN. Finally, this method reduced the use of energy devices while stripping the LNs, alleviating the damage to nutrient vessels and the impact on the blood supply of the left RLN, avoiding excessive tension on the nerves, thereby limiting the damage to the left RLN.

This study inevitably had some limitations that should be noted. Firstly, this was a single-institutional and retrospective cohort study with significant differences in the number of patients between the two groups and the lack of matching. Secondly, laryngoscopy was not performed to evaluate the vocal cord mobility of all patients, and hoarseness was considered to be the main criterion for evaluating RLN palsy. Thirdly, hoarseness was assessed by auditory impression, which was prone to subjective bias that could be overcome by applying voice analysis in a future study.

Conclusions

In conclusion, the results of this study showed that the novel method applied not only increased the number of LN dissections along the left RLN but also decreased the incidence of hoarseness, suggesting that our novel method for LN dissection along the left RLN in patients in the semi-prone position during McKeown MIE is safe and reliable.

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Footnote

Reporting Checklist: The authors have completed the STROBE reporting checklist. Available at https://jgo.amegroups.com/article/view/10.21037/jgo-22-1273/rc

Data Sharing Statement: Available at https://jgo.amegroups.com/article/view/10.21037/jgo-22-1273/dss

Conflicts of Interest: All authors have completed the ICMJE uniform disclosure form (available at https://jgo.amegroups.com/article/view/10.21037/jgo-22-1273/coif). The authors have no conflicts of interest to declare.

Ethical Statement: The authors are accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. The research protocol of this clinical study was approved by the Ethics Committee of the Sir Run Run Shaw Hospital (No. 20220314-33). The study was conducted in accordance with the Declaration of Helsinki (as revised in 2013). All patients provided written informed consent.

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