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Review

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Dissection of the lymph nodes along the recurrent laryngeal nerve in robotic esophagectomy

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Abstract
Lymph node (LN) metastasis serves as a pivotal prognostic determinant in esophageal cancer, particularly in cases of squamous cell carcinoma (SqCC). The involvement of LN metastasis frequently extends to the LNs along the recurrent laryngeal nerve (RLN). Radical dissection of these nodes is imperative for precise staging and the prevention of loco-regional recurrence. Historically, the emphasis on RLN node dissection has been evident in numerous literature, establishing it as a mandatory procedure in different countries. Nevertheless, the risk of RLN palsy following such dissection is a substantial concern, given its association with significant postoperative complications and long-term implications for quality of life. Recent literature has highlighted RLN node dissection in robotic surgery, demonstrating favorable outcomes in comparison to alternative surgical modalities. This review paper aims to comprehensively assess prior publications on this subject, elucidating the outcomes and implications of RLN node dissection in robotic esophagectomy (RE).

Keywords: Esophageal cancer, robotic surgery, recurrent laryngeal nerve, survival

INTRODUCTION
Lymph node (LN) metastasis is one of the most important prognostic factors in esophageal cancer. In esophageal squamous cell carcinoma (SqCC), bidirectional LN metastasis happens. In upward lymphatic metastasis, the metastasis to the LNs along the recurrent laryngeal nerve (RLN) is most common. The complete dissection of the LNs along the RLN is an important procedure for the accurate staging and the

prevention of loco-regional recurrence. We herein briefly review the current status of robotic esophagectomy (RE) and share our institute's outcomes, primarily focused on the dissection of the LNs along the RLN.

HISTORICAL BACKGROUND

Historically, radical LN dissection in the upper mediastinum was documented during the 1980s and 1990s[1]. This surgical procedure gained significant popularity, particularly in Japan; however, it was infrequently performed in Western countries. A seminal contribution to the field is represented by a key paper published in the Annals of Surgery in 1994 by Akiyama *et al*., distinguished experts in esophageal cancer surgery. In this publication, Akiyama *et al*. reported on radical LN dissection techniques employed in esophageal cancer, marking a pivotal advancement in the understanding of this specialized surgical approach[2].

The authors documented the metastatic patterns of esophageal cancer based on the primary tumor's location. One of the key findings of this study is the notable prevalence of metastasis to the upper mediastinum and cervical LNs, with the RLN vicinity being the most common site of metastasis. Consequently, the authors conducted a radical LN dissection, now referred to as three-field LN dissection. Japanese surgeons pioneered this technique, reporting highly favorable outcomes postoperatively. In this paper, the authors conducted a comparative analysis of long-term survivals between two-field and three-field LN dissections, revealing that three-field LN dissection yields superior overall survival compared to two-field LN dissection. However, caution must be exercised in interpreting these findings due to the study's non-randomized design. The authors initially performed two-field LN dissection in the earlier cases and transitioned to three-field LN dissection in the later cases. This lack of randomization introduces a potential bias that needs careful consideration. Nevertheless, following the publication of this paper, three-field LN dissection has gained widespread popularity in Japan, and in several institutes in other countries, it is now performed as a routine procedure for esophageal cancer surgery.

Japanese surgeons also assessed the efficacy index of mediastinal and abdominal LNs in esophageal cancer surgery[3]. The efficacy index is calculated by multiplying the incidence of metastasis and long-term survival, signifying that a higher efficacy index for a LN station indicates greater effectiveness of dissection for that station compared to others. In a study composed of 3,827 patients[4], examining the efficacy index based on the location of the primary tumor reveals that, in upper mediastinal esophageal cancer, the highest efficacy index is identified in the upper mediastinal LN area, which covers the recurrent laryngeal LN area. Consequently, for upper and middle esophageal cancer, the recurrent laryngeal LN area emerges as the most effective region, demonstrating both a high metastasis rate and significantly higher long-term survival rates following LN dissection. Even in lower esophageal cancer, the efficacy index of the upper mediastinal area remains high, underscoring the necessity of upper mediastinal LN dissection for all esophageal cancer cases [Table 1]. Also, a recent study conducted by Japanese surgeons elucidated the efficacy index of each regional LN station based on the results of 612 esophagectomy patients[5]. The right RLN LN station showed the 1st highest efficacy index and the left RLN LN station showed the 6th highest efficacy index out of 26 regional LN stations. This study in detail highlights the utmost importance of both recurrent laryngeal LN dissection in esophageal cancer surgery.

CURRENT GUIDELINES

The Japanese Esophageal Society has provided guidelines regarding the extent of LN dissection[6]. In accordance with the 11th edition of guidelines, the committee recommends D2 dissection for esophageal cancer, where D2 signifies dissection to the extent of Group 2, denoted by the color blue [Figure 1]. As per

Table 1. The efficacy index of each zone according to tumor location for esophageal SqCC

LN zone	Upper esophageal cancer *n* = 629	Mid esophageal cancer *n* = 2,215	Lower esophageal cancer *n* = 983
Supraclavicular zone	14.1	9.2	5.3
Upper mediastinal zone	17.6	15.0	8.2
Middle mediastinal zone	3.0	6.1	4.7
Lower mediastinal zone	1.4	3.9	8.4
Perigastric zone	3.1	9.3	17.8
Celiac zone	0.0	1.0	2.9

This table is adapted from Tachimori *et al. Esophagus.* 2016;13:1-7. Springer Nature[4] (https://doi.org/10.1007%2Fs10388-015-0515-3) under the terms of the Creative Commons Attribution 4.0 International License (http://creativecommons.org/licenses/by/4.0/). SqCC: Squamous cell carcinoma; LN: lymph node.

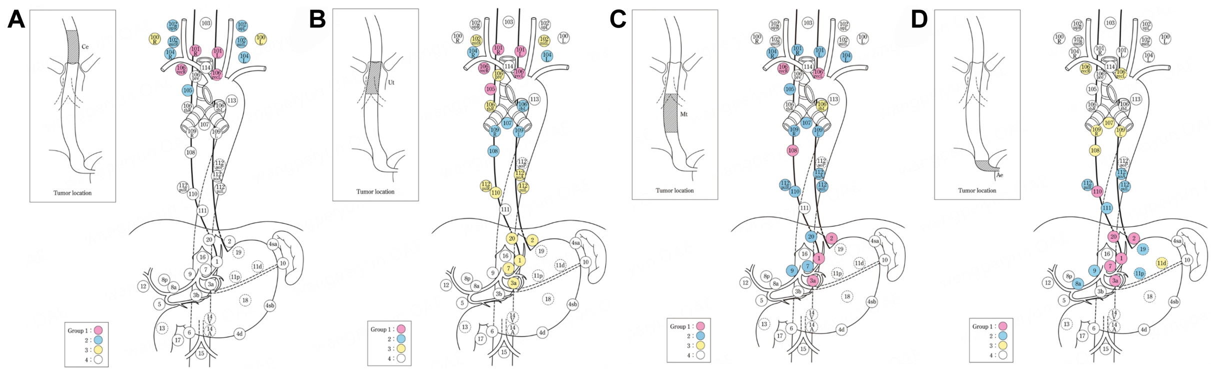

Figure 1. LN groups according to the location of the tumor. (A) LN groups for tumor located in cervical area; (B) LN groups for tumor located in upper thoracic area; (C) LN groups for tumor located in middle thoracic area; (D) LN groups for tumor located in lower thoracic area. This figure is adapted from Japan Esophageal Society. *Esophagus.* 2017;14:1-36. Springer Nature[6] (https://doi.org/10.1007%2Fs10388-016-0551-7) under the terms of the Creative Commons Attribution 4.0 International License (http://creativecommons.org/licenses/by/4.0/). LN: Lymph node.

their recommendations, regardless of the primary tumor's location except abdominal area, the dissection of both recurrent laryngeal LNs is advocated.

In the Japanese classification of esophageal cancer, 106recR refers to the right recurrent laryngeal LN, and 106recL designates the left recurrent laryngeal LN [Figure 2]. Additionally, 106tbL is also regarded as part of the left recurrent laryngeal node. The inclusion of 106tbL in Group 2 varies among institutions, making the decision to dissect this area dependent on each institute's preference. In the American Joint Committee on Cancer (AJCC) staging system, describing the location of recurrent laryngeal LNs is challenging, with 106recL corresponding to 2L and 4L in this system. However, there is no specified location for 106recR in the AJCC system. At times, it is considered as 2R, but 2R denotes paratracheal LNs, indicating a distinct location. Hence, I will describe the recurrent laryngeal LN as 106recR and 106recL in this article.

Recently, the Japanese Esophageal Society published the 12th edition of the Japanese Classification of Esophageal Cancer. In this edition, N staging is categorized based on the number of LN metastases to align with the AJCC/Union for International Cancer Control (UICC) system. However, the requirement for dissection of both recurrent laryngeal LNs remains unchanged.

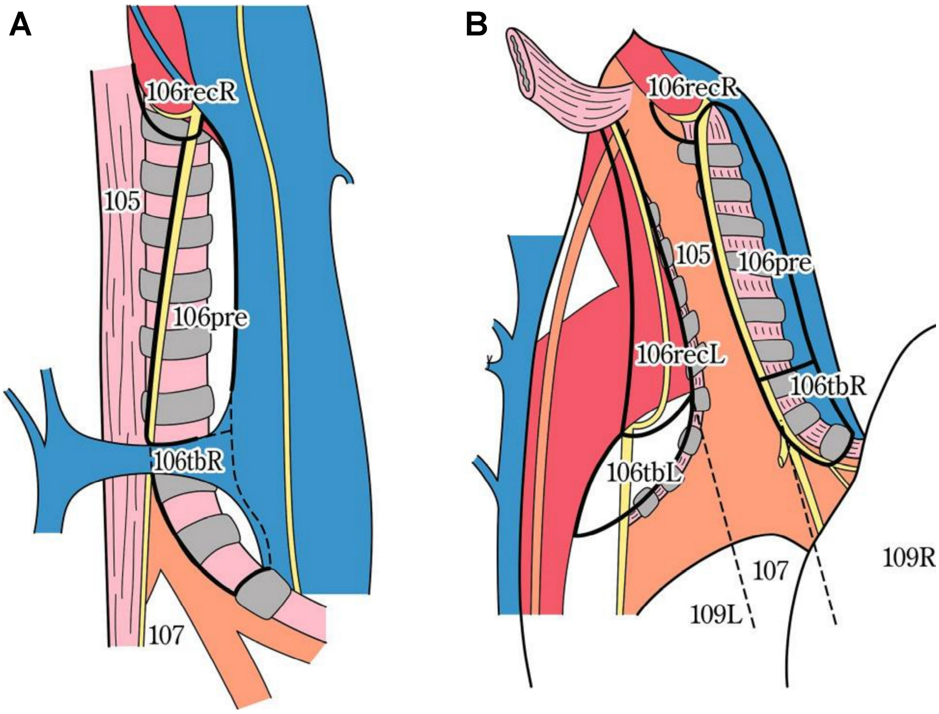

Figure 2. Tracheobronchial LNs. (A) Right view of the trachea; (B) Posterior view of the trachea. This figure is quoted from Japan Esophageal Society. *Esophagus*. 2017;14:1-36. Springer Nature[6] (https://doi.org/10.1007%2Fs10388-016-0551-7) under the terms of the Creative Commons Attribution 4.0 International License (http://creativecommons.org/licenses/by/4.0/). LNs: Lymph nodes.

For cervical and thoracic esophageal cancer, D2 or greater lymphadenectomy is preferred for accurate pathological diagnosis of LN metastasis. D2 LN dissection for cervical esophageal cancer includes LNs 100, 101, 102 mid, 104, 105, and 106rec. For thoracic esophageal cancer, D2 dissection involves complete removal of two-field LNs.

RISK FACTORS OF RLN PALSY

The reason many surgeons hesitate to perform recurrent laryngeal LN dissection lies in the potential risk of RLN palsy. Inducing palsy in the RLN can significantly deteriorate the quality of life for patients, and in severe cases, it may lead to critical aspiration pneumonia[7]. Therefore, comprehending RLN palsy and its associated risk factors is of utmost importance. Traditionally, several factors, such as old age, prolonged operation time, obesity, and cervical anastomosis, have been recognized as risk factors for nerve palsy. However, recent studies have proposed two additional factors: the size of the nerve and the soft tissue area surrounding the nerve, as supplementary risk factors. This presentation will elucidate the findings pertaining to these last two risk factors.

A paper by Saito *et al*. focuses on comparing the size of the RLN, with particular emphasis on the left RLN[8]. The authors categorized participants into two groups based on nerve size, using a 1.5-millimeter diameter as the threshold. Following LN dissection along RLN, the study revealed a significant difference in left RLN palsy between the two groups. In the thin nerve group, 71 percent of patients experienced postoperative palsy, whereas in the thick nerve group, only 24 percent of patients exhibited palsy (P value < 0.001). The paper underscores that smaller nerve sizes render them more susceptible to surgical damage. The key takeaway from this study is clear: heightened caution is warranted during LN dissection along RLN when dealing with nerves of smaller dimensions.

In a study published in 2021[9], the authors conducted measurements of the soft tissue area surrounding the RLN. According to their findings, a larger soft tissue area correlates with an increased likelihood of RLN palsy, aligning well with their surgical observations. Area around left RLN (> 174.3 mm^2) was a significant risk factor for left RLN palsy in multivariate logistic regression analysis (HR = 15.4286, 95%CI: 3.2522-73.1929, *P* value = 0.0006). Notably, in cases of obesity or a substantial presence of fatty or lymphatic tissue around the RLN, the incidence of palsy rises. This observation underscores the challenge of accurately identifying the RLN and preserving it without surgical damage when confronted with a substantial amount of soft tissue. Therefore, it is imperative to exercise caution during dissection when a significant soft tissue volume is identified around the RLN.

Other critical factors to consider during RLN evaluation include the precise location of metastasis. Notably, metastasis around the RLN predominantly occurs in the cervical area rather than the thoracic area. A study in 2017 analyzed the exact locations in relation to the sternal notch and trachea[10]. The findings revealed that most right RLN metastases were detected above the sternal notch, while half of left RLN metastases were situated in the cervical area. Additionally, substantial differences were observed in the depth of these locations. On the right side, metastasis typically occurred in the posterolateral side of the trachea, indicating a superficial area. Conversely, left RLN metastasis extended to much deeper areas. Consequently, LN dissection along RLN on the right side may suffice with superficial dissection, whereas on the left side, a more radical dissection into the deeper tracheal space becomes necessary. This discrepancy in the depth of metastasis contributes to the higher incidence of left RLN palsy compared to the right side.

RE AND LN DISSECTION

In a study conducted by Ruurda *et al.* in 2015, the authors presented a wide range of the median number of LNs harvested in REs over the past decade across different countries, ranging from 14 to 43[11]. Papers from Japan and South Korea demonstrated a significantly higher number of LNs, attributable to the performance of recurrent laryngeal LN dissection in these countries. Conversely, in other countries where LN dissection along RLN was not conducted, the number remained around 20.

The key insight gleaned from this study is that robotic surgery alone does not guarantee a higher number of harvested LNs. The quantity of harvested LNs is contingent on how the robot is utilized and whether dissection around the RLN is performed. With increased surgeon experience, there is a potential for improved LN yield and reduced palsy rates with robotic surgery.

Lastly, the extent of LN dissection can influence the removal of LNs around the thyroid gland, classified as 1R or 1L in AJCC classifications. As the number of harvested LNs is influenced by the surgeon's policy and experience, a direct comparison between different centers remains challenging, emphasizing the need for caution in interpretation.

The efficacy of robotic surgery compared to conventional video-assisted thoracic surgery (VATS) in enhancing the outcomes of LN dissection along RLN remains a subject of debate. Some studies have suggested that robotic surgery yields a higher number of LNs and a lower incidence of vocal cord palsy. Recently, three meta-analyses comparing robot esophagectomy and VATS esophagectomy were conducted including the LN number and vocal cord palsy [Table 2].

While robotic surgery demonstrated a relatively higher number of dissected LNs especially in the field of 106recL in these meta-analyses, the disparity should be further investigated in more future studies. And the rate of vocal cord palsy was comparable between the robotic and VATS esophagectomy groups.

Table 2. Meta-analyses comparing RE and VATS esophagectomy since 2021

Authors	Year	Number of included studies	Total number of harvested LNs	Statistics	Number of included studies	Number of 106recL	Statistics	Number of 106recR	Statistics	Number of included studies	Palsy rate	Statistics
Mederos *et al.*[12]	2021	8 RCS[13-20]	R = VATS	MD -1.10 (95%CI: -2.45~0.25)	NA	NA	NA	NA	NA	6 RCS[13-15,17,19,20]	R = VATS	RD of 0.01 (95%CI: -0.08~0.10)
		1 RCT[21]	R > VATS	MD -6.40, (95%CI: -10.09~ -2.71)	NA	NA	NA	NA	NA	1 RCT[21]	R = VATS	RD of -0.03 (95% CI: -0.11~0.05)
Chen *et al.*[22]	2021	11 RCS[14,15,17,19,20,23-28] + 1 RCT[21]	R > VATS	MD 0.171 (95% CI: 0.086~0.255)	4 RCS[15,20,26,27]	R > VATS	MD 0.219 (95%CI: 0.097~0.340)	R = VATS	MD 0.10 (95%CI: -0.06~0.26)	13 RCS[13,14,15,17,19,20,23,24,26-30] + 1 RCT[21]	R = VATS	RR 0.88 (95%CI: 0.67~1.14)
Zhang *et al.*[31]	2023	10 RCS[14,15,17,19,20,23,24,26,27,32]	R > VATS	MD 1.18 (95%CI: 0.06~2.30)						11 RCS[14,15,17,20,23,24,26,27,29,30,33] + 1 RCT[34]	R = VATS	R: 16.28% *vs.* VATS 21.96% (OR = 0.80; 95%CI: 0.57~1.12; P = 0.19)

Meta-analyses from Chen *et al.* and Zhang *et al.* analyzed the same studies in evaluating the number of 106recL and 106recR[22,31]. RE: Robotic esophagectomy; VATS: video-assisted thoracic surgery; LNs: lymph nodes; RCS: retrospective cohort study; MD: mean difference; NA: no relative data were mentioned in the original articles; RD: risk difference; RCT: randomized controlled trial; RR: relative risk; R: robot; OR: odds ratio.

Apart from previous meta-analyses, it is worthwhile to focus on the only randomized controlled study published in the English literature to date: the robot-assisted minimally invasive esophagectomy (RAMIE) trial[34], which compared RE and VATS esophagectomy. While the number of dissected LNs and the rate of vocal cord paralysis were similar, the counts of thoracic LNs, right RLN node, and left RLN node after neoadjuvant therapies were higher in RE, with a significance level of 0.05. Also, the achievement rates of left RLN node dissection after neoadjuvant therapy were significantly higher in RE compared to VATS esophagectomy (79.5% *vs.* 67.6%, P = 0.001).

Many researchers are eagerly anticipating the results of another randomized controlled trial, the REVATE trial[35], which compares RE and VATS esophagectomy. The primary outcome of the REVATE trial is the rate of unsuccessful LN dissection along the left RLN. In relation to the subject matter of this review article, the REVATE trial is expected to provide definitive insights into the left side.

Currently, there is insufficient firm evidence to assert the superiority of robotic surgery over VATS esophagectomy. However, as surgeons gain more experience with RE, there is a possibility of achieving better results in terms of LN yield and lower rates of complications. This improvement could be attributed to the learning curve associated with robotic surgery. It is important to note that some earlier studies may have included cases from the initial stages of the learning curve, which might have influenced their findings.

HOW WE DO IT

When performing RE, we typically employ the 4-arm technique for both chest and abdominal procedures[36]. In the chest procedure, the ports are usually positioned on the anterolateral side due to its reduced postoperative pain and advantageous access to the posterior mediastinum. Additionally, the vertical placement of ports proves highly beneficial during esophagectomy, as it facilitates coverage of a vast area extending from the neck to the diaphragm. This configuration proves especially helpful when conducting extensive dissection in RE [Figure 3].

Based on previously mentioned studies and findings from our institute's experience, we adhere to specific principles when conducting LN dissection along RLN [Table 3]. We prefer employing the semi-skeletonization method and performing a half-circumference dissection, particularly in left-sided dissections. This involves keeping the RLN partially attached to the mediastinal structure rather than completely detaching it. Typically, the dissection direction starts laterally and proceeds medially. While energy devices can be utilized, we maintain a distance of five millimeters or more from the RLN to mitigate thermal damage. In intrathoracic LN dissection along RLN, we consistently check the upper border of the dissection to ensure proximity to the inferior thyroid artery.

When performing right recurrent laryngeal LN dissection, the initial step involves using robotic scissors to open the mediastinal pleura. Afterward, identification of the vagus nerve (VN) ensues. The subsequent task is to locate the right RLN, typically positioned just below the subclavian artery. This is generally more straightforward than on the left side. LNs around the right RLN, designated as 106recR, become visible, and the separation of vascular and nerve branches along the RLN commences. Progressing upward, the inferior thyroidal artery is visualized, setting the upper boundary for nerve dissection. In this area, approximately half of the lymphatic tissue comprises cervical paraesophageal LNs, while the other half constitutes mediastinal intrathoracic LNs. Following the separation from the RLN, attached tissues are removed, completing the right-side recurrent laryngeal LN dissection. During dissection of 106recR, the posterolateral side is typically located superficial, sufficing dissection for the RLN LN. Deep dissection around the nerve is generally unnecessary, and postoperative nerve palsy after right-side dissection is infrequent. This illustrates the outcome after the complete dissection of the RLN, displaying the esophagus, trachea, and RLN [Figure 4A].

Left-side dissection poses more challenges compared to the right side due to the greater length of the nerve, necessitating a more radical approach. During left-side dissection, we typically prefer using a cold cut. When utilizing an energy device, we ensure a considerable distance from the nerve to prevent thermal damage.

We prefer to access the left RLN space anterior to the esophagus, between the trachea and esophagus. Dissect the tissues to expose the aorta at the base. During this process, retract and rotate the trachea using the #4 robot arm and use bipolar forceps to grasp the trachea. Intubation with a single-lumen endotracheal tube with a blocker is essential for handling the trachea and for dissection along the left RLN.

After separating the esophagus and trachea, continue dissection downward until the left main bronchus is visible. Ensure that the tissue between the esophagus and left RLN remains intact for easier subsequent dissection. We aim to locate the left RLN near the left main bronchus bifurcation, as variations in the left RLN are minimal in this area based on our experience. Occasionally, multiple nerves may be present; typically, the middle nerve is the left RLN. To confirm, track the nerve caudally to identify the recurrent site, which runs deep to the operative field. Then, continue tissue dissection cranially along the left RLN.

Table 3. Institutional preference in RLN LN dissection using robot

En bloc semi-skeletonization is preferred
Half-circumference dissection (especially in left RLN LN dissection)
Keep the RLN LN attached to mediastinal structure
From lateral to medial direction
Energy device should be used keeping a distance of 5 mm or more from RLN
Identify inferior thyroid artery in both sides

RLN: Recurrent laryngeal nerve; LN: lymph node.

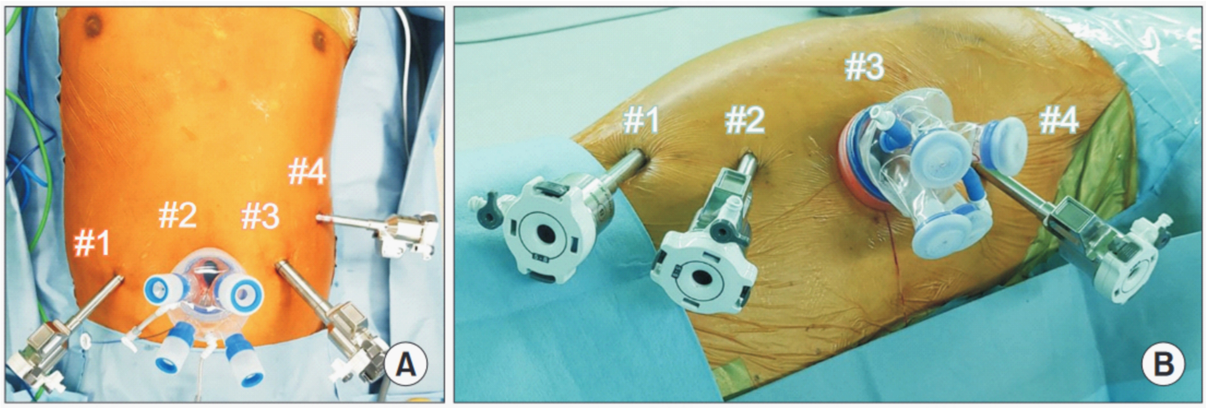

Figure 3. Port placement for the abdominal (A) and thoracic (B) procedures. The labeled numbers represent the robotic arm number. Robotic staplers are inserted in arm no. 2 during abdominal procedures and in arm no.3 during thoracic procedures. A 12-mm port is necessary for the robotic stapler arm. An assistant surgeon can share the glove port with the robot, and an additional assistant port is not necessary. This figure is adapted from Park *et al. J Thorac Dis.* 2016;8:2853-61[24] (https://doi.org/10.21037%2Fjtd.2016.10.39) under the terms of the Creative Commons Attribution-Non Commercial-No Derivatives 4.0 International License (CC BY-NC-ND 4.0) (https://creativecommons.org/licenses/by-nc-nd/4.0/).

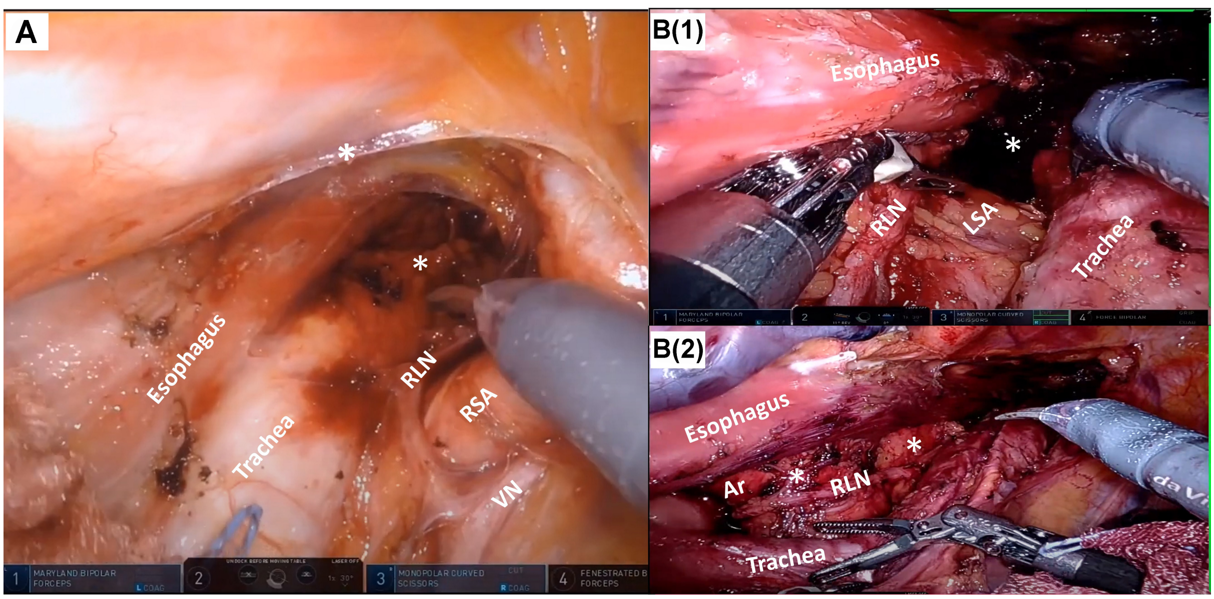

Figure 4. Intraoperative view after dissection of RLN LN in right side (A) and (B) left side. B(1) represents the cranial side, and B(2) represents the caudal side, near right main bronchus bifurcation site). *represents the space at which RLN LNs were located. RLN: Recurrent laryngeal nerve; LN: lymph node.

Following dissection up to the level of the thyroid gland, we proceed to remove the cervical paraesophageal lymphatic tissues. The nerve and thyroid gland become visible, and most lymphatic tissues below the thyroid gland are removed. As mentioned earlier, deep dissection to the anterior side of the trachea is performed due to the presence of lymphatic tissues in this region.

In terms of radicality, left-side dissection is more extensive than the right side, increasing the likelihood of nerve palsy. We refrain from fully skeletonizing the left RLN, preserving the posterior side tissue to protect vascular structures and maintain the structural integrity of the nerve. After completing the LN dissection along the left-side RLN, the entire course of the nerve and the tissue below the thyroid gland, between the trachea and esophagus, is visible. The upper cervical area reveals a substantial, hollow space post-LN dissection, with all nerves clearly visualized [Figure 4B].

For a more detailed understanding of the LN dissection along RLN, you can see videos in these links. (Right side: https://www.youtube.com/watch?v=8hmRQJjt6JU. Left side: https://www.youtube.com/watch?v=AAc1Urv0de4).

OUR CENTER'S EXPERIENCE

We published our early series of RE in 2016, comparing RE and VATS esophagectomy in terms of LN numbers across different LN stations[24]. This paper represents our initial experience, encompassing approximately 70 cases of robotic surgery. Notably, the total number of harvested LNs along both RLN tracts in this study was only 7. Despite the modest number, we observed a significant difference, leading us to report a higher count of dissected LNs in RE compared to VATS esophagectomy in the total number of dissected LNs (37.3 ± 17.1 *vs.* 28.7 ± 11.8; P = 0.003) and the number of LNs dissected from the upper mediastinum (10.7 ± 9.7 *vs.* 6.3 ± 9.3; P = 0.032). Five-year overall survival was not different between the two groups (69% in RE and 59% in VATS esophagectomy; P = 0.737).

After accumulating more cases in robotic surgery, we conducted a comprehensive analysis, reporting the long-term outcomes in a recent publication[37]. Our study included 178 patients who underwent robotic surgery, representing an expansion from our previous work. After propensity score matching between the RE group and open esophagectomy (OE) group, each group had 136 patients. At this juncture, the number of LNs around both RLNs had increased to 10, a notable augmentation from the earlier count of 7. Each side of recurrent laryngeal LN was dissected more in RE than in OE [Table 4]. The heightened emphasis on recurrent laryngeal LN dissection in RE led to a significant reduction in LN recurrence compared to OE (RE 84.1% *vs.* OE 62.7%, P = 0.03). Moreover, the robotic surgery group demonstrated a noteworthy decrease in major complications (RE 8.1% *vs.* OE 20.0%, P < 0.01), a primary contributor to non-cancer-related deaths post-esophagectomy.

CONCLUSION

The LN dissection along RLN is a crucial step in esophageal surgery, especially in SqCC. Robotic assistance is a useful tool for LN dissection along RLN. Increased harvesting yield and prevention of vocal cord palsy are expected. However, a multi-center randomized clinical trial on this issue is necessary. Although the effect of radical LN dissection on long-term survival is unclear, decreasing loco-regional recurrence and potentially improving long-term survival is expected.

Table 4. Number of dissected LNs according to LN stations in the matched groups

AJCC map 8th	JES map 11th	RE (*n* = 136)	OE (*n* = 136)	*P* value
1R	101R 104R	2.8 ± 5.8	2.0 ± 6.5	0.27
1L	101L 104L	2.8 ± 6.1	1.4 ± 4.9	0.04
2R (right RLN)	106recR	3.8 ± 3.6	2.0 ± 2.6	< 0.01
2L 4L 10L (left RLN)	106recL 106tbL	6.4 ± 4.8	4.7 ± 4.8	< 0.01
8U	105	0.6 ± 1.5	0.6 ± 1.7	0.83
7	107	6.2 ± 4.1	5.8 ± 4.2	0.30
8M 8L	108 110 112ao	6.5 ± 4.4	5.1 ± 4.6	< 0.01
9	112pul	0.4 ± 1.5	0.6 ± 1.3	0.56
10	109R 109L	0.5 ± 1.2	0.5 ± 0.8	1.00
15	111	0.2 ± 0.6	0.2 ± 0.8	1.00
16 17	1 2 3 7	10.0 ± 8.0	9.5 ± 7.4	0.54
18	8	1.5 ± 2.1	1.6 ± 2.7	0.71
19	11p 11d	0.7 ± 1.4	0.7 ± 1.8	0.94
20	9	0.4 ± 1.0	0.8 ± 1.8	0.01

This table is cited from Na *et al.J Robot Surg.*2022;16:841-8. Springer Nature[37] (https://doi.org/10.1007/s11701-021-01298-1) under the terms of the Creative Commons Attribution 4.0 International License (http://creativecommons.org/licenses/by/4.0/). LNs: Lymph nodes; AJCC: American Joint Committee on Cancer; JES: Japanese Esophageal Society; RE: robotic esophagectomy; OE: open esophagectomy; RLN: recurrent laryngeal nerve.

DECLARATIONS

Authors' contributions

Made substantial contributions to conception and design of the study and performed data analysis and interpretation: Na B, Kang CH

Availability of data and materials

Not applicable.

Financial support and sponsorship

None.

Conflicts of interest

Kang CH is a consulting doctor for Intuitive Surgical Korea, while Na B declared that he has no conflicts of interest.

Ethical approval and consent to participate

Not applicable.

Consent for publication

Not applicable.

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